(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 782 730 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
18.06.2003 Bulletin 2003/25

(21) Application number: **95933897.1**

(22) Date of filing: **22.09.1995**

(51) Int Cl.[7]: **G06F 17/00**

(86) International application number:
PCT/US95/12059

(87) International publication number:
WO 96/009588 (28.03.1996 Gazette 1996/14)

(54) INTERACTIVE PROGRAMMING METHOD

VERFAHREN ZUM INTERAKTIVEN PROGRAMMIEREN

PROCEDE INTERACTIF DE PROGRAMMATION

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **23.09.1994 US 311019**

(43) Date of publication of application:
09.07.1997 Bulletin 1997/28

(73) Proprietor: **ACTV, INC.**
New York, NY 10020 (US)

(72) Inventor: **FREEMAN, Michael, J.**
New York, NY 10020 (US)

(74) Representative: **Needle, Jacqueline et al**
W.H. BECK, GREENER & CO
7 Stone Buildings
Lincoln's Inn
London WC2A 3SZ (GB)

(56) References cited:

EP-A- 0 460 867	**WO-A-90/15389**
GB-A- 2 271 005	**US-A- 4 870 591**
US-A- 5 043 891	**US-A- 5 239 617**

- **BLAKOWSKI G ET AL: "TOOL SUPPORT FOR THE SYNCHRONIZATION AND PRESENTATION OF DISTRIBUTED MULTIMEDIA" COMPUTER COMMUNICATIONS, vol. 15, no. 10, 1 December 1992, pages 611-618, XP000321682**

EP 0 782 730 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a method for providing expert based interactive programs, and to a method and interactive terminal for receiving expert based interactive programs.

[0002] "Interactive" systems are known in the art, particularly in the context of interactive television or telephone systems. In most cases, the "interactivity" provided by these systems enables a user of the system to control what is seen or heard on the system by pressing buttons on a two-way controller or touch-tone keypad. However, these systems provide only a low level of conversational responsiveness.

[0003] Systems which emulate interactive conversation are also known in the art. These systems use a variety of different techniques to achieve interactive conversation, and have ordinarily had limited success at conversations which were more than mere simple question and answer sessions. In the context of multiple choice response systems for children, such systems are exemplified in U.S. Patents Nos. 2,921,385; 3,020,360; 2,826,828, 3,623,238; 3,546,791; 3,273,260; 3,665,615; 3,245,157; 3,284,923; 3,538,621; 3,477,144; 3,708,891; 3,255,536; 2,777,901; 2,908,767; 3,774,316; 3,194,895; 3,484,950; 3,343,280 and 3,763,577, for example.

[0004] Various interactive television systems have also been developed. For example, U.S. Patents Nos. 4,264,924, 4,264,925, and 4,507,680 disclose interactive cable television systems. US Patent No. 5,585,858 describes an interactive system which is usable by both conventional television viewers and interactive television viewers. Other examples of interactivity utilizing television are described in U.S. Patents Nos. 4,602,279; 4,847,700; 4,573,072; 4,847,698; 4,847,699; and 4,918,516, for example. Generally these systems require a separate microprocessor to perform selection and memory functions and are not concerned with expert system analysis.

[0005] While such prior systems have the flexibility and memory-like characteristics for establishing personalized interactive environments, they do not provide interactive programming which enables programming of media-independent complex interactive conversations in which the interactive conversation includes expert analysis of specific user problems, for example, financial analysis services, document creation, point-of-sale marketing systems, etc.

[0006] Some of the systems which are capable of performing expert analysis are known in the computer field as rule-based expert systems. In a rule-based expert system, a knowledge base provides expert-quality solutions to problems in a specified area. Generally, the information in the knowledge-base is extracted from human experts and the system attempts to emulate their problem-solving methodology. With their inherent limitations (see "Computer Engineering Handbook", C.H. Chen, Editor, McGraw-Hill, Inc. pp. 9.1-9.35), such systems are useful for performing expert analysis in certain situations. These expert systems have not been implemented on an interactive basis to a large audience.

[0007] EP-A-0460867 provides an expert system on a computer terminal which uses multimedia to present information and to receive user commands. This expert system is primarily designed to assist a person to perform equipment maintenance tasks.

[0008] What is needed is a system which can take interactive systems to the next level, a level which allows for more complex and thereby meaningful conversation and interaction between the system and the user. Such a system would perform expert analysis and be usable by a very large number of people simultaneously, and would not be limited to any particular transmission technology.

[0009] According to the first aspect of the present invention there is provided a method for providing expert based interactive programs to an interactive terminal such that a high level of conversational responsiveness and interactivity is achieved, the method comprising:

defining a goal for the expert based program;
developing rules leading to the defined goal, the rules comprising at least one premise and a conclusion whereby the rules are related hierarchically to one another in that a conclusion of at least one of the rules is a premise of another rule;
forming queries, each query corresponding to a premise which requires a user response to determine the existence of the premise;
mapping the queries and rules into a plurality of data streams to generate an interactive program, the plurality of data streams containing frames, the frames being time-synchronized between data streams, and at least one frame containing an information portion and a command portion; and
storing the data streams in an interactive storage medium such that the expert based interactive program is retrievable for provision to an interactive terminal.

[0010] The invention also extends to a method for receiving an expert based interactive program at an interactive terminal, the interactive program comprising a plurality of data streams, the method comprising:

receiving the plurality of data streams, each data stream having a plurality of time-synchronized frames, wherein

the frames contain embedded expert system rules and queries, the rules being hierarchically related to one another and comprising at least one premise and a conclusion;
selecting a frame from a single data stream out of the plurality of provided data streams using a signal selector, whereby the selected frame comprises a query;
presenting the query to a user through an interactive output device;
receiving a user entry in response to the presented query;
determining a next frame hierarchically related to the selected frame, the next frame determined being based on the received user entry and the selected frame; and
obtaining the next frame using the signal selector, whereby the next frame contains another query or a conclusion to an expert system rule.

[0011] According to a further aspect of the present invention there is provided an interactive terminal for receiving an expert based interactive program, said interactive terminal comprising:

means for receiving one or more data streams, each data stream having a plurality of time-synchronized frames comprising premises, queries, and conclusions which represent rules of a hierarchical rule-base, the hierarchical rule-base formed in that at least one premise of one rule is a conclusion of another rule;
a signal selector for selecting a frame out of the provided data streams, wherein the selected frame comprises instructions indicating a query;
means for receiving the selected frame and generating an interactive query based on the instructions of the received frame;
an interactive output device for presenting the generated query to a user;
means for receiving an entry from the user in response to the generated interactive query; and
means using the signal selector to obtain a next frame from the provided data stream, where the next frame contains another query or a conclusion to an expert system rule.

[0012] Embodiments of the methods of the invention enable the preparation and presentation of an interactive scenario comprising a plurality of time-synchronized separable data streams which are related in content to one another. The data streams may be broadcast over a transmission medium or stored on a storage medium. The interactive scenario is designed for playback on an apparatus comprising means for selectively retrieving the data streams from the storage medium or transmitted signal; the selected data streams are chosen as a result of expert analysis.

[0013] In the programming method, a decision-making goal is defined for the interactive scenario. This may be, for example, the diagnosis of a problem, or the creation of a document on the basis of information entered by a user. Once the goal has been defined, a set of rules is developed which will logically lead to the defined goal. Each rule has one or more premises, and a conclusion. The rules relate hierarchically in that the conclusions of at least some of the rules are premises for other rules. Moreover, the rules are logically related to the goal in that the conclusion of at least one of the rules corresponds to the decision making goal.

[0014] Usually, the premises of the rules are translated into queries; or questions which are presented to the user. The queries may be in multiple-choice, true-false, or short answer form. However, premises which are not user-dependent (i.e., those determined by the conclusions of one or more other rules) need not be translated to queries because user responses are unnecessary.

[0015] From the hierarchical rules and queries (if necessary), a hierarchical tree may be created to implement the rules. The hierarchical tree contains branches which are dependant on the user solicited answer to a query or the existence of a premise.

[0016] The hierarchical tree is mapped into a plurality of time-synchronized frames, located on a plurality of data streams. Preferably, each frame has an informational field which corresponds to a query, a premise, a conclusion, an informational message, or combinations thereof. A command portion of each frame may contain frame identification data and information relating to the rule. This information may direct the interactive terminal to switch to certain streams depending upon the user's response, may instruct the interactive terminal to store and/or perform functions on a variable, or may contain a software instruction for the interactive terminal. Each frame preferably comprises a complete message which provides a response which corresponds to the selection of the stream. Alternatively, the frames may refer to internal or external storage available to the interactive terminal which contains prestored messages.

[0017] In an embodiment, the frames are located on the streams in a predetermined sequence according to the hierarchical tree for providing a continuous flow of interactive conversation for ultimately reaching the decision-making goal. An information portion of some of the frames contains queries soliciting user interactive responses. The user interactive responses correspond to other associated frames which contain further queries, premises or conclusions related to the previously presented queries.

[0018] In the simplest embodiment, the positioning of the frames in the data streams corresponds to the hierarchical

tree. Because the structure of the program may not necessarily require use of all of the channels at any given time, a dynamic embodiment is disclosed which dynamically varies the number of channels in use based on the needs of the expert analysis as embedded in the program. In a further embodiment, stream switching commands and efficient frame positioning conserve channel capacity by causing the locations of the frames to correspond to "folded" branches of the hierarchical tree. This results in a system with fewer hierarchical tree branches and thus fewer data streams.

[0019] The data streams containing the frames are stored in a storage media, thus preserving the hierarchical interactive scenario for future recall and presentation. When the hierarchical interactive scenario is to be presented, the storage media recalls the stored data streams and provides them to an interactive terminal sequentially at frame intervals. In a preferred embodiment, the storage media only provides the data streams containing useful information, thus dynamically allocating the data streams. The interactive terminal gathers a frame at a time from the provided data streams and interactively presents the queries, conclusions, or informational messages contained on the gathered frame to one or more users. The users respond to the queries by entering a response, which is interpreted by the interactive terminal in conjunction with the command portion of the gathered frame. The interactive terminal will continue with the interactive presentation by using the result of the interpretation to obtain a next frame from the same, or different, data stream, according to the command portion of the gathered frame. The appropriate frames will be presented to the user until the entire interactive scenario has been completed.

[0020] Embodiments of the invention are able to provide expert analysis in the form of real-time interactive conversation in a manner which is suitable for mass-distribution.

[0021] The invention enhances the personalized feedback responses of an interactive system through the provision of expert analysis embedded primarily in interactive programming.

[0022] Embodiments of the invention have the advantage that interactive programming for an expert system may be provided in a manner which requires little processing at the interactive terminal.

[0023] Embodiments of the present invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a block diagram of apparatus for implementing an interactive expert system of the invention;
Figure 2 is a block diagram showing the steps in a method of programming an interactive expert system of the invention;
Figure 3 is a hierarchical graph of an interactive expert system rule-base, discussed herein as Example 1;
Figure 4 is a hierarchical tree diagram of the Figure 3 hierarchical graph;
Figure 5 depicts the positioning of frames on five data streams in an embodiment to realize the Figure 4 hierarchical tree;
Figure 6 depicts a generalized presentation of the Figure 5 frame locations in a manner which illustrates the hierarchical nature of the embodiment;
Figure 7 depicts a generalized representation of an alternative embodiment employing compressed hierarchical tree branches to realize the hierarchical tree of Figure 4 using only three data streams; and
Figures 8A, 8B, 8C and 8D depict a generalized representation of frame locations and contents to realize Example 2.

[0024] Referring now to the drawings in detail, and initially to Figure 1, embodiments of the invention employ an interactive terminal (2) for receiving and selecting among interactive data streams for interactive media (4) for presentation to a user on a display (9). The terminal (2) contains an infrared remote receiver (6) for receiving user inputs from infrared remote control (8). The receiver (6) is connected to a signal selector (3) which selects the data stream and frame that will be received by the interactive terminal (2). A display generator (7) is connected to the signal selector (3) for generating an interactive display based on the received data stream. In an alternative embodiment, optional storage device (5) is used to present prestored messages, as directed by the received frame on the selected data stream.

[0025] The terminal (2) is a multitrack playback device, storage device or multichannel reception device. The data streams are separate channels or tracks of audio, video, graphics or other data from the interactive media (4). Interactive media (4) can be any of the following: a multi-track audio tape; a multi-track video tape; a video tape or a transmitted signal having a single video channel and multiple audio and/or graphics channels; multiple channels of video; a single video signal having several video channels compressed and multiplexed thereon; a two way video system in which the content of a single video channel may be switched at the head end based upon user input sent from the user site; a randomly accessible storage media (i.e. a magnetic disk or tape, CD-ROM or other optical storage media, or any other type of randomly accessible storage media); or any type of storage media in which separable tracks of audio or video may be stored for later transmission. All of the above transmission schemes of the present invention can be implemented as analog or digital signals and sent on any transmission medium including cable, satellite, broadcast television, microwave, personal communications networks. For example, the audio channels may be transmitted in

serial, parallel or any suitable form, as discussed in US Patent No. 5,585.858.

[0026] If the interactive media (4) is randomly accessible, the interactive conversation streams are either physically stored on individual disk track, or in contiguous or non-contiguous files. In conjunction with a disk drive, or an appropriate interface for the type of storage media in use, the information stored on each track is output to a user of the system in near real-time fashion. In one embodiment, multiple video channels are stored on CD/ROM or VideoDisc, and the disc controller handles separating the multiple channels for selective display.

[0027] In a preferred embodiment, the interactive media (4) comprises one or more cable television channels, each of which contains a transmitted audio and video signal. Using a multiple choice controller (8), the user is able to selectively respond to queries, the responses are their input into the expert system which commands a switch between the channels on the media (4) so as to conventionally display the information from each channel on display (10).

[0028] If audio or video tapes are used as the multi-track media (4), or CD-ROM, or disk storage is used, the media is preferably removable from the playback means so that different interactive expert systems may be inserted and used in the system. This makes it possible to record a library of prerecorded media, covering a wide array of topics. For example, the media (4) may contain expert analysis for product selection, diagnoses, document creation, etc. The system may employ a microprocessor for reading the tracks from a randomly accessible media, if such media is used.

[0029] As described below, while the present invention emulates memory functions during operation, a complex microprocessor is not required to perform any of these memory functions. The logic and memory functions are achieved through hierarchial rule-based programming. Nonetheless, one detailed example of the invention (Example 2) is described, which utilizes a microprocessor to handle memory functions for providing a more complex degree of expert analysis.

[0030] The interactive conversation is preferably seen and/or heard by the user using a conventional television display, and/or speaker or headphones. If the stored conversations on the multi-track media are in digital form, i.e. CD-ROM magnetic disc, or digital audio tape (DAT), the interactive terminal (2) contains a digital-to-analog converter to convert the digital information streams to analog signals which may be output to a conventional audio/video display or speaker.

[0031] While not required, storage device (5) may be used by the interactive terminal (2) when the data from the interactive media (4) contains instructions directing the terminal to present "canned" interactive messages stored in the storage device (5).

[0032] Multiple choice controller (8) may be an infra-red remote control, or may be any other appropriate device to select an interactive response to a query. Depending on the particular application, inputs may be provided via a keyboard or even a touch screen. Once a response is entered, the system may change data streams appropriately, store the response for future branching, or execute an algorithm utilizing the response. Alternatively, a multiple choice controller (8) is not necessary with the present invention if the interactive terminal incorporates buttons enabling the user to make selections on the terminal itself.

[0033] As previously indicated, while prior art interactive systems are able to engage users in relatively simple interactive conversations, and emulate memory functions, the prior art does not disclose a method of creating an interactive program which is capable of performing expert analysis or complex functions.

[0034] The present system emulates a computerized expert system in presenting an interactive program without the use of a microprocessor for tracking all user responses. Moreover, the video display which is preferred in the present invention provides a more realistic expert analysis by enabling the system to explain how and why a particular conclusion was reached, to display recommended products, and to demonstrate how to accomplish a needed repair once the system has concluded that such a repair is necessary.

1. Implementation of a Rule-Base.

[0035] In order to properly program the interactive expert system, a rule-base must be defined. This enables the system to emulate the decision making process of a human expert at a remote location, i.e., at the interactive terminal and the television display. By placing the present system at remote sites, the interactive expert system enables complex problems to be solved during separate interactive conversations with many users. The present invention introduces a way to organize in-depth knowledge into an interactive programming methodology to ensure proper emulation of the decision-making process.

[0036] Figure 2 shows a flow chart of the method of the present invention for implementing an interactive expert system. First, the goals of the expert system are defined at step 10. Next. the appropriate human knowledge is extracted to achieve those goals, step 11. Informative works, experts, and other sources are consulted to determine this knowledge. From the human knowledge, a hierarchial rule-base is defined at step 12. The hierarchial rule-base is an organizational characterization of the human knowledge.

[0037] The rule-base consists of a number of rules. Rules comprise mapping conclusions to one or more premises. The rule base is formulated to implement the human knowledge defined at step 11 and solve the goals defined at step

10. The rule-base is hierarchial because at least one premise of one rule is a conclusion of at least one other rule. Table 1, shown below, is an example of a rule-base. A graphical representation of the Table 1 rule-base is shown in Figure 3.

[0038] If a rule assumes a premise which is user-determinative, the premise is translated into a query at step 13. The interactive system presents the query to the user to determine whether the premise is satisfied. For example, if a premise to a rule is "the car is red", the corresponding query "is the car red?" is generated to solicit the user's response whether the premise is satisfied. The query need not mirror the premise but could be anything which would prove or disprove the existence of the premise. For example, the query could be "is the car blue?". If an affirmative answer is received, the interactive terminal will know that the premise "the car is red" is not satisfied. If a negative answer is received, other queries must be presented, until the interactive terminal has enough information to determine whether the premise is satisfied.

[0039] Next, the remaining rules, premises, and queries are formed into a hierarchial tree diagram, step 14. The hierarchial tree diagram broadly represents a logical solution (using branches) to the problem and corresponds to the rule-base and queries. An example of a hierarchial tree diagram is shown in Figure 4.

[0040] The hierarchial tree diagram is mapped into a plurality of data streams, step 15. The data streams contain frames which are time synchronized between the data streams. The frames contain information on the data stream relationships depending on user input. In essence, the data streams represent and implement the branches of the tree diagram. Figure 5 depicts a series of data streams mapped from the hierarchial tree diagram of Figure 4. In a preferred embodiment, the mapping step includes the step of "folding" the hierarchial tree diagram. The "folding" step reduces the number of required data streams by causing branching between and among streams which are no longer necessary to implement the hierarchial tree diagram, thereby conserving channel capacity. An example of a "fold" is shown in Figures 6-7, Figure 7 representing one way of folding the embodiment depicted in Figure 6.

[0041] Lastly, the data streams are stored in an appropriate storage device, step 16. In a preferred embodiment described below, the data streams are stored in a manner which enables dynamic retrieval of the data streams. In this embodiment, an indicator relating to those streams containing information is also stored. During retrieval, only those streams identified by the indicator are retrieved.

[0042] The following two examples will be used to demonstrate the method of the invention:

1) A simple expert system for diagnosing a problem occurring in a stereo system, the problem being that excess noise and distortion are heard through the loudspeakers.

2) A point-of-sale kiosk, which includes a microprocessor, for assisting a user in choosing a tennis racket.

[0043] As previously mentioned and shown in Figure 2, the first step in the process of programming an interactive expert system is to define the goals of the decision-making algorithm of the system 10. The goals define the type of expert advice the system provides to the user. More specifically, the goals of the system define an end point, final decision or product of the expert system. Referring to example (1) above, the goal is to analyze the user's responses to queries, and to determine the most likely reasons that the stereo speakers contain excess noise and distortion. In example (2), the system inquires into the user's playing habits and personal characteristics, and recommends a tennis racket which is most suited to the user's style of play and experience.

[0044] In the first example, a rule-base to determine the cause of excess noise output from loudspeakers in a stereo system is defined as shown in Table 1.

Table 1: Rule-base for Stereo System Diagnostic Example.

Rule 1: **If the outputs are getting a clean signal,** **and the speaker cable does not pick up noise,** **then the problem is with the speakers.**
Rule 2: **If the speaker cable picks up noise,** **then the problem is with the speaker cable.**
Rule 3: **If the interconnect cable picks up noise,** **then the problem is with the interconnect cable.**
Rule 4: **If the volume control knob, or** **the balance knob,** **or the tone control knobs,** **cause noise, then** **the problem is with the wipers on the knobs.**
Rule 5: **If the headphone output has no noise,** **and the interconnect cable does not pick up noise,** **then the outputs are getting a clean signal.**

[0045] In this simple example, rules are defined for locating the source of a problem in a stereo system where the speaker audio contains excess distortion and noise. Each rule contains at least one premise and a conclusion. The premise corresponds to the phrases above beginning with "if". The conclusion corresponds to the phrase following "then". For example, in Rule 1, the premises are (1) "the outputs are getting a clean signal" and (2) "the speaker cable does not pick up noise." The conclusion is "the problem is with the speakers." The premises are translated into queries, preferably presented to the user via the display monitor either prior to storage, or after reception by interactive terminal. For Rule 1, the query may be (1) "are the speaker cables pinking up noise when the cables are moved while the stereo is playing?" The query is preferably not this brief, but provides a detailed interactive presentation, as shown below in Table 2. Premise (2) for Rule 1 is hierarchically dependant on the outcome of Rule 5, and uses the outcome of Rule 5 as its premise without requiring the use of a query. However, the two premises of Rule 5 require queries. A hierarchial relationship occurs because the conclusion of Rule 5 "the outputs are receiving a clean signal", is used as a premise of Rule 1.

[0046] Once the rules have been defined, they are organized into a hierarchical rule-base of the type graphically shown in Figure 3. The hierarchical rule-base graph visually shows the hierarchical organization of the premises and the conclusions. In order to code an expert system into a multi-channel television system and take advantage of the parallelism of the multiple channels, parallelism in the knowledge base should be identified. Parallelism are points in the logic of the system where the decision making paths separate based upon the existence of a premise. Because the premises are often translated into queries, it is also correct to define a parallelism as occurring at points in the logic of the system where the decision making paths separate based upon answers to queries. For example, using the hierarchical graph shown in Figure 3, the response to the premise "the speaker cables do not pick up noise" establishes parallel paths. If the speaker cables do not pick up noise, a path is established to determine if the problem is the speaker (Rule 1). If the speaker cables do pick up noise, then a parallel path is established to inform the user that the problem is with the speaker cable (22). These two paths are mutually exclusive. Accordingly, an important aspect of efficient coding of a multi-data stream system is to identify mutually exclusive paths which may be coded in parallel on the data streams. Once the hierarchical graph has been constructed and parallelism identified, the expert system implementa-

tion may be mapped into a multi-data stream format and the resulting interactive presentation stored on a storage medium.

[0047] In addition to simply recording the queries and conclusions, the system may Include an explanation facility which is implemented in the interactive presentation. This is possible because of the hierarchial relationship between the rules. At any one conclusion, the prior premises are satisfied, since such premises had to have been met to arrive at the conclusion. For example, the system need not merely state that "the noise is caused by the speaker", but rather the more Informative response that "the noise is caused by the speaker because the speaker cables do not pick up the noise, the headphone output has no noise, and the interconnect cables do not pick up the noise." Thus, each rule provides a context for the explanation given in the expert system. A user is informed of the underlying basis of the expert system's opinion. The system thus emulates dialog between the system user and an expert.

[0048] The rule base is preferably organized so that the premise that is most likely to fail or is easiest to confirm is tried first This provides the opportunity to eliminate a rule (and to thereby conserve valuable media space) as early in the search as possible. In Rule 1 of the stereo example, the premise "the speaker cables do not pick up noise" (20) should be tested before "the outputs are receiving a clean signal" (21), because the determination of premise (20) will resolve Rule 2.

[0049] As with conventional expert-based systems, there is always a certain ambiguity in the rule-base. This occurs because the premises are often incapable of positive proof. For example, in Rule 5, the premise "the headphone output has no noise" (23) may be true, but the conclusion "the outputs are receiving a clean signal" may be false if the noise is caused by a subsequent stage of the amplifier located after the internal headphone signal pickup. Thus, as with all expert systems, the heuristic nature of the system causes the system to be only as good as the underlying rule-base. This problem can be mitigated to some extent in an alternative embodiment of the present invention using a processor and assigning probabilities to the mappings between premises, user responses, and conclusions. In the preferred embodiment, only those ambiguities which are known in advance may be compensated for by defining a field along the graph and including explanatory messages about the ambiguity in this field, i.e., "the system cannot determine what is wrong based on the information you have entered. Please check the service manual or call your authorized dealer."

2. Hierarchial Tree Diagram

[0050] Referring to Figure 4, after the expert rule-base and hierarchial graph are constructed, some or all of the premises are translated into queries, and a hierarchial decision tree is developed for the interactive presentation. This enables the interactive provider to structure the interactive presentation in a format which is able to be easily received and accessed by one or more interactive terminals.

[0051] Figure 4 illustrates one simple hierarchial tree diagram of the Table 1 rule base and Figure 3 hierarchial graph. As described above, the "speaker cables do not pick up noise" premise of Rule 1 is presented first, because it is determinative of the outcome of Rule 2. Thus, the first branch of the tree (41) is a query "Do the speaker cables pick up noise?" (Table 2, below, shows a more complete indication of how the actual query preferably appears). This query is presented to the user with the display monitor (9). If the user indicates via the user interface (8) that the speaker cables pick up noise, then according to Rule 2, the problem is in the speaker cables (43). Thus, if a "yes" answer is received from the interactive response, the tree branches to a data stream to explain that the problem is with the speaker cables (43).

[0052] If the speaker cables do not pick up noise, the first premise of Rule 1 has been satisfied, and the interactive presentation moves to branch (42), to inquire about the second premise. The second premise is a conclusion of Rule 5, and thus a query relating to Rule 5 must be generated by the system. Since the Rule 5 premise "the interconnects do not pick up noise" is determinative of Rule 3, this premise is processed first. Thus, the second branch (42) presents the query "do the interconnects pick up noise?" If the interactive input indicates that the interconnects pick up noise, then rule 3 is satisfied, and the interactive terminal presents a summary of the problem, stating that "the problem is with the interconnects" (44).

[0053] If the interconnects are not generating noise, as indicated by the user interactive response, the first premise of Rule 5 has been satisfied, and a query directed to the second premise is generated for display to the user. The decision tree moves to branch (45) and queries the user "do the headphone outputs contain noise?" If the interactive response is "no", then all the conditions of rule 1 have been satisfied and the conclusion may be presented to the user that "the problem is the speaker" (46).

[0054] If the user had interactively responded that the headphone outputs contained noise, the premises of Rules 1-3 and 5 have not been satisfied and the presentation must move to the next untested rule, Rule 4. While Rules 1 and 5 required two premises to have been met (a logical "AND" function). Rule 4 differs in that it is satisfied if any of three preconditions are met (a logical "OR" function). Only one query covering the three alternatives needs to be generated to determine if a premise of Rule 4 is satisfied. Thus, the decision tree branches to a query (47), which

states "does the balance control, volume control, or tone control generate noise?". If the answer is affirmative, the problem is with the resistive wipers on the rotary controls, and the presentation moves to a representation of this conclusion (48), "the problem is the wipers on the control knob which generated noise."

[0055] If the user interactive input indicates that the noise is not caused by the volume, balance, or tone controls, then none of the requisite premises of Rules 1-5 are met. At this point, the tree may branch to other more detailed questions, or the presentation may inform the user "the problem is probably in the electronics, consult your authorized dealer for repair" (49).

[0056] Once the hierarchial tree diagram has been constructed, it is a simple matter to store the interactive presentation for subsequent recall. To store the interactive presentation, time synchronized data streams containing frames are generated and stored.

3. Data Streams

[0057] Once a hierarchial tree diagram, similar to that shown in Figure 4, has been constructed, the premises, queries, conclusions, and associated informational statements are mapped onto data streams. Information is embedded on the data streams in a plurality of frames, each frame comprising messages which are seen and/or heard in response to the selection of the data stream upon which the frame is embedded. Each of the frames on the various data streams comprise queries, conclusions, statements based upon the conclusions to the premises, and associated informational messages to provide context for the queries, premises and conclusions. The contents of the streams are related in real-time so that user choices presented in response to a premise result in a switch to data streams which are related hierarchically according to the hierarchial rule-base graph or in context to the premise which resulted in the channel switch. The frames on the various tracks relate in real-time and content so that an expert analysis occurs as the media is played back and the user responds to queries related to the premises of the expert system stored in the streams.

[0058] As a channel is selected in response to an interrogatory or based on the response to an earlier interrogatory, the information on the data stream corresponding to the particular selection is routed to the display. Embedded in the selected data stream at the time selection occurs is a frame segment having content corresponding to the selected response to the previous query. The queries, premises, conclusions, and explanatory messages may generally be contained on any or all of the various tracks provided they are synchronized properly so as to retain a timed relationship as discussed herein.

[0059] Referring to Figure 5, a representation of data streams and frames are shown which realize the hierarchial diagram of Figure 4. Figure 5 shows five data streams (101-105). Although five data streams are shown in this embodiment, more or less can be provided as necessary. Each data streams (101-105) contains a first frame (200). Each frame (200) contains an information portion (210) and a command portion (220). The data streams (101-105) need not be formatted so that the command portion (220) succeeds the information portion (210), as shown in Figure 5, but may be formatted in any way currently known to one of ordinary skill is the art. For example, the command portion (220) may precede the information portion (210) or may be interleaved with the information portion (210).

[0060] The information portion (210) preferably contains a representation of either a conclusion or a query. For example, the information portion (210) may state either "the problem is the speaker" (246) or "do you hear noise on the headphone output?" (245). The queries will solicit an interactive response from the user. Even the conclusions can require an interactive input, such as "the problem is with the speaker, press any key to continue".

[0061] The information portion (210) is not limited to text, but may also contain graphics, video, audio, or instruction codes. For example, the information portion (210) may contain a graphical or video representation of a man and a woman with accompanying audio of a voice asking "what is your gender? Enter 1 for male, 2 for female." Alternatively, the information portion (210) may contain an instruction code which references memory locations in a storage device (5) available to the interactive terminal. The interactive site uses the instruction code to reference the corresponding storage location for accessing "canned" interactive data.

[0062] In analog embodiments, the information portion (210) is preferably included in the vertical blanking interval of a conventional television signal, or on a dedicated channel. These and other acceptable techniques are disclosed in US Patent No. 5,585,858.

[0063] The command portion (220) is preferably used both to control functions of the interactive terminal (20) and to define the hierarchical relationship between the frames (200). The command portion (220) contains branching data concerning the interactive terminal's response to specified user inputs. For example, the command portion (220) may contain algorithmic codes to match user inputs to system responses embodied in separate data streams. The coding may also be more complicated. For example, relative addressing of data streams may be used ("switch to the third lower stream"), variable assignments may be represented ("if user presses 1, store 3 in variable X"), and other well know instructions to an interactive processor may be included. The complexity of the command is tailored to the complexity of the interactive terminal which processes the command. Of course, suitable coding can be used to conserve the size of the command portion. Alternatively, the commands may contain codes that identify macros stored at the

interactive terminal, the macros comprising the branching algorithms as depicted above.

[0064] Because the command portion (220) contains the information which defines the relationship between frames (200). the frames (200) preserve the hierarchial relationships of the hierarchial tree diagram (Figure 4).

[0065] Returning to Figure 5, the hierarchial branches occur through switching between data streams. It is evident that the hierarchial relationship between the frames is directly analogous to that of the branches in Figure 4. In Figure 5, information portions (241, 242, 245. and 247) correspond to queries (41, 42, 43, 45, and 47) in Figure 4. The yes/no branches of the Figure 4 queries are preserved in the command fields (341, 342, 345, and 347) of the frames shown in Figure 5. For example, if the response to the query "are the interconnects picking up noise?" (42) (Figure 4) is "No", then the tree diagram branches to "does the headphone output contain any noise" (45). In Figure 5, the query (42) of Figure 4 is stored in information portion (242), and the instructions on where to branch depending on the input are stored in command portion (342). The command portion (342) remains on channel 101 if the answer is "no", and switches to channel 102 if the answer is "yes". This correlates with the hierarchial tree diagram of Figure 4. In Figure 5, the conclusions represented in information portions (243, 244, 246, 248, and 249) correspond to conclusions (43, 44, 46, 48, and 49) of the hierarchlal tree diagram shown in Figure 4.

[0066] Figure 5 shows one embodiment where the frames of the different data streams are synchronized. The frames are synchronously located in frame intervals between T1, T2, T3, T4, and T5. As depicted, the period between T3 and T4 appears longer than the period between T1 and T2. In a preferred embodiment, it is not required that the time intervals be identical, but only that the frames be synchronous. All the frames in Figure 5 are shown to be synchronous, even though portions of the frames may be of different length, such as the information portions (242 and 243).

[0067] Because the number of actual branches in a given interactive scenario varies depending on the user's interactive responses, the interactive scenario reaches completion at different times. For example, in Figure 5, the user has completed the interactive program at frame (243, 343) where the problem is the speaker cables. Had the user indicated that the speaker cables were not the cause of the problem, the user would be interacting with frame (242, 342). In this example, the interactive provider has included "program synchronization segments" in the frames which do not correspond to logical branches on the hierarchial tree diagram. The program synchronization segments are inserted into the channels to maintain a synchronous relationship amongst the channels for subsequent branching. This is done by placing a command to remain on the current stream in the command portion (343) of the final frame (243, 343). The information portion contains an informational message which is not required to be related to the rule-base, but is included to preserve the timing of the system. Frames subsequent to the program synchronization segments have further informational messages in the information portion, and commands to stay on the current channel in the information portion. Alternatively, if the problem is solved in frame (243, 343), a code could command the branch to a separate channel, not shown, which provides common programming or further instructional video until the end of the expert interaction.

[0068] It may not be desirable to maximize stream efficiency by reducing the number of parallel tree branches when coding a hierarchial rule-base into a hierarchial tree diagram, especially where multiple users are simultaneously involved with the interactive presentation. By purposefully coding to an inefficient hierarchial tree diagram (by using many data streams), the interactive program is structured to conclude at the same (or nearly the same) time for different possible interactive responses, reducing the necessity for program synchronization segments. For example, if an interactive TV program broadcast takes a half hour to conclude for user A and fifteen minutes to conclude for user B, user B may be unhappy to view fifteen minutes of program synchronization segments. Of course the program synchronization segments may be another short interactive program, which would be unavailable to user A. It is thus important to recognize that the artisan may wish to trade-off the number of streams and the length of time it takes to resolve the various decision tree branches to reach an overall conclusion.

[0069] At the final frames on the data streams, occurring at time T4, all the possible branches of the hierarchial tree diagram have been presented. The command portion of the final frames on each data stream may contain a command to switch to a single data stream so that the next interactive presentation may begin. The frames at time T4 and T' contain a command portion (350) instructing the interactive terminal to switch to data stream (101). This is desirable to conserve storage and media space. In fact, the data streams are preferably structured to be allocated dynamically, as described immediately below.

4. Dynamic Allocation of Data Streams

[0070] In a preferred embodiment, the data streams are provided dynamically from interactive media (4). The number of data streams actually provided to the interactive terminal is only the number of data streams actually carrying information. This results in a substantial saving of channel capacity, in the embodiment where data streams are encoded onto channels for transmission.

[0071] Referring to Figure 2. the step of mapping the hierarchial tree diagram into data streams and time-synchronized frames (15) entails mapping only data streams which are required by the interactive scenario. For each frame

interval it is only necessary to send the data streams actually carrying information. For example, referring to Figure 4, the first step is to determine whether the speaker cables are bad (41). This requires one frame on a single data stream. Therefore, in the first frame interval T0 - T1 (Figure 5), only data stream (101) is provided to the interactive terminal. The frame intervals are shown in Figures 5 and 8 as the intervals between T0, T1, T2, ..., Tn.

[0072] In one embodiment, initially when the frames containing information (in the information and command portion) are stored, an indication of which frames in the data stream contain the information is also stored. This may be accomplished in a number of different ways. First, an index containing the number of data streams may be stored in the interactive media (4) during each frame interval. For each frame interval, the index would inform the interactive media (4) of the number of data streams containing information, and thus the number of data streams which should be generated for transmission. Alternatively, the index could comprise a list of data streams for each succeeding frame interval and whether the data streams should be generated for that frame interval.

[0073] A second method to store an indication of the data streams to be generated for transmission during a particular time interval is encoding the command portion of each frame with a field identifying the data streams that will be available on the succeeding frame interval. This method is advantageous because the interactive terminal (2) receives a frame containing information pertaining to the upcoming number of data streams. The interactive terminal may use this information to configure itself for data stream switches.

[0074] A third method to store an indication of the data streams to be generated is encoding the command portion of a frame on a designated data stream with an index (as described above) field identifying the data streams that will be available on the succeeding frame interval. For example, data stream (101) in Figure 5 could contain an index field in each frame to inform the interactive media (4) how many data streams should be generated. Since the interactive terminal (2) may not receive the data stream containing the index field (depending on the interactive input from the user), the interactive media may not receive an indication of the number of data streams which will be presented on the next frame interval, unlike the second method, above. However, the invention will still function. as it is unnecessary (although desirable for the purpose of configuring the interactive terminal (2) in advance) for the interactive terminal (2) to know which data streams will be provided in the next frame interval. The interactive terminal merely switches to a data stream identified by the command portion of the frame and the user's interactive response.

[0075] With reference to Figure 5, at time T0 the interactive provider need only supply a single data stream, at T1 two data streams, at T2 three data streams, and so on until five data streams are required at time T4. Thus, the interactive system is able to dynamically allocate the data streams between a single channel and as many channels as necessary. If the data streams were provided on television channels, then the number of channels required at the early times (T0 and T1) is effectively reduced. For example, four streams/channels are necessary for a query calling for four age brackets, while two streams/channels are required for a binary or polar query (ie. a yes/no query). Referring to Figures 5 and 8, the portions of the data streams labeled "unused" are preferably not provided during their corresponding frame intervals, dynamically reducing the number of data streams.

[0076] Alternatively, the interactive terminal may continue to process the prior data stream when a new interactive presentation is to occur. In this instance, redundant messages are placed on multiple data streams so that all users receive the same initial presentations no matter which data stream the user had concluded with in the previous interactive scenario. This alternative embodiment is stream-inefficient in that all the channels are being used throughout the interactive presentation, rather than just at the end, as in the previous embodiment.

[0077] A modification of this alternative embodiment is that the introductory messages of further interactive presentations present information relating to previous interactive presentations. In this case, all users do not receive the identical presentations when beginning new interactive programming. Since there are many possible commands to place in the command portion of the frames, dynamic allocation of data streams, and great flexibility in constructing the hierarchial tree diagram, the invention is very flexible and can be arranged in numerous configurations.

[0078] The data streams (101-105) need not be stored synchronously, but may be stored in any manner known to the artisan. The storage or recording method is not critical to the invention, as long as it is sufficient to enable the retrieval method to read the stored data streams synchronously.

5. Timing and Branching of Frames on the Data Streams.

[0079] Again referring to Figure 5, the timing and frame contents are depicted as they occur on data streams (101-105). At time T0, the user has finished a previous interactive presentation and is beginning to interact with the stereo problem solving presentation. Since all the prior frames occurring at time T' contain instructions (350) to switch to stream (101), the interactive terminal only processes a single data stream (101). At time T1, the interactive terminal stays on stream (101) or switches to stream (102) depending on the user's response to the query (241) posed at time T0. At time T1, the interactive terminal receives streams (101) and (102) regardless of the user's selection. It is not necessary for the terminal to process all the incoming data streams. Only performing a simple switching operation and processing of the selected data stream is required of the interactive terminal. This continues until time T4 when all the

possible branches on the tree have been presented. The frames at time T4 all have a command portion (350) instructing the interactive terminal to switch to stream (101) at the conclusion of the presentation. Thus, at time T5, the interactive processor is processing stream (101) again.

[0080] Another reason for beginning and ending on a single data stream is that it makes other data streams available for error processing. For example, in Figure 5. frame (230, 330) is directed to a presentation dealing with a situation where the user had not selected "y" or "n" as instructed by frame (241, 341). The information portion (230) contains a message such as "you did not select 'y' or 'n', therefore it is assumed you pressed 'n' ...."

[0081] Table 2 shows a possible script for the information portion of the frames depicted in Figure 5 and the queries shown in Figure 4. It is understood that this example represents the audio portion of the program, and that appropriate video may be included in the information portion of each frame as well. Information or instructions included in the command portion of the frames are shown enclosed by brackets {}.

[0082] The stream numbers 101-105 in Table 2 correspond to streams 101-105 in Figure 5, while the times T' - T5 also correspond to the times T' - T5 shown in Figure 5. The frames numbered in Figure 5 also appear in Table 2, at their corresponding positions, although they have not been separately numbered in the Table.

TABLE 2:

Script of Frame Contents for Stereo Diagnostic Example.					
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**	**Stream 105**
T' T	... {stay on 101}	... {switch to 101}	... {switch to 101}	... {switch to 101}	... {switch to 101}
T0	Welcome to the Electronic Repair Shop. I understand that you are having problems with your stereo because extra noise and distortion come out of the speakers. Let's see if I can help. Let's check those speaker cables. Grasp them one at a time and move them around while playing your stereo. Also. try and change the location of the speaker cables. Do you hear a change in the noise level or distortion when you move or change the location of the speaker cables? Press 1 for no, 2 for yes. {if 1 stay on 101. if 2 switch to 102, any other key- switch to 103.}	(unused)	(unused)	(unused)	(unused)

EP 0 782 730 B1

TABLE 2: (continued)

Script of Frame Contents for Stereo Diagnostic Example.					
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**	**Stream 105**
T1	Well, it looks like the speaker cables are O.K., lets check the interconnect cables. Try and wiggle the cables connecting the CD player, tuner, tape deck, or amplifier as the stereo is playing. Do you hear a change in the noise and distortion as you are doing this? Press 1 for no and 2 for yes. {if 1, stay on 101, if 2 switch to 103.}	I see that the speaker wires are making noise as you move them while the unit is playing. The problem is probably in the speaker wires, they are likely picking up interference from nearby electrical devices. I suggest rearranging the speaker cable or purchasing shielded speaker cable. {stay on 102}	Ooops, you didn't select a 1 or 2. I'll assume you meant to pick 1; your speaker cables do not create any noise. Try and wiggle the cables connecting the CD player, tuner, tape deck, or amplifier as the stereo is playing. Do you hear a change in the noise and distortion as you are doing this? Press 1 for no and 2 for yes. {if 1, switch to 101, if 2 stay on 103.}	(unused)	(unused)
T2	It's good that the speaker cable and interconnects are working well. Lets check the headphone output on your amplifier to see if the noise is inside your amplifier as well as your speakers. Do you hear the noise and distortion over headphones connected to the headphone output on your amplifier? Press 1 for no, 2 for yes. {if 1, stay on 101, if 2, switch to 104}	I am glad that I have been able to fix your problem. Did you know that ACE Stereo's service shop is the #1 rated repair shop in the area? {stay on 102}	If the interconnects are making noise when you move them around, it probably means that they are picking up electrical noise and distortion. Try and rearrange the interconnect cables in a way to minimize the problem. You may also want to stack your equipment differently or purchase shielded interconnect cables. Press any key to continue. {Stay on 103}	(unused)	(unused)

TABLE 2: (continued)

Script of Frame Contents for Stereo Diagnostic Example.					
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**	**Stream 105**
T3	Since there is no noise or distortion coming out of your headphone output, the problem is probably your speakers. They may be blown. Remember that ACE stereo supply sells quality speakers from brands such as Bose, KLH, Snell, Vandersteen, and Velodyne. Press any key to continue. {stay on 101.}	When purchasing new speaker cables, you might want to also upgrade other components of your stereo for improved sound. ACE sells quality stereo components from these brands: Adcom, Pioneer, Sony ES, and Krell. {stay on 102}	I was glad to be able to solve your problem. Remember that the salespeople at ACE Stereo are eager to help you solve any other problems which may arise. {stay on 103}	Hmmm... The noise must be coming from inside your equipment. Lets now quickly check the control knobs. Select "tape" from an input, but do not play your tape recorder. Set the volume to a normal level and slowly rotate the volume knob, balance knob, and tone control knob. Does rotating these knobs cause noise and distortion? Press 1 for no and 2 for yes. {if 1 stay on 104, if 2, switch to 105}	(unused)

TABLE 2: (continued)

Script of Frame Contents for Stereo Diagnostic Example.					
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**	**Stream 105**
T4	I was glad to help solve your problem. It was fun to learn about your stereo system. Please standby for another interactive program. {stay on 101}	I hope you enjoyed your interactive presentation. Please standby for another interactive program. {switch to 101}	I hope you enjoyed your interactive presentation. Please standby for another interactive program. {switch to 101}	Gee, I can't figure out what is wrong based upon the data available to me. I think its probably an electrical problem with one of your components. I would suggest calling your authorized dealer. Sony that I couldn't help, but remember that I evolve just as experts do, so maybe next time you use me I'll have a better understanding of your equipment. Please standby for another interactive program. {switch to 101}	Ah ha, the wipers on your control knobs have probably picked up dirt. or oxidized over time. I bet you don't rotate those knobs all the way around very often. Turn the power off and rotate the knobs freely to clean the resistive wipers. If this does not fix the problem, you will have to have a professional clean them for you. ACE Stereo's service department is able to do this service for only $49.99. I 'm glad to have been of service. Please standby for another interactive program. {switch to 101}
T5	{new program.}	(unused)	(unused)	(unused)	(unused)

6. Folding the Branches on the Hierarchial Tree Diagram.

[0083] Note that in Figure 5, the branches of the hierarchial tree diagram require the use of five data streams (101-105) at time T4. Although the system is capable of dynamically assigning data streams, there is another preferred way to reduce the number of data streams.

[0084] Figure 6 shows a generalized hierarchial tree chart of the hierarchial tree diagram depicted in Figure 4 and the data streams shown in Figure 5. The locations of the data streams are shown in dashed lines in Figure 6. The information portions (210) of the frames (200) are shown in Figure 6 with similar numbering as in Figure 5. The command portions, where shown, are illustrated as branches in the tree chart.

[0085] Because the information streams are capable of carrying branching instructions, and because of the hierarchial nature of the expert system, the number of streams may be reduced by "folding" the branches of the hierarchial tree. The "folding" approach simply optimizes the required number of streams required by making use of the program synchronization segments.

[0086] An example of "folding" the Figure 6 hierarchial tree is shown in Figure 7. Rather than remaining on data stream (103) after information portion (244), command portion (344) may instruct the interactive terminal to switch to data stream (102). This normally leads to an incorrect presentation because stream (102) is associated with the conclusion that the problem is in the speaker cables (243) while the conclusion represented at (244) is that the problem is in the interconnects. However, interim frame (251, 351 and 252, 352) are program synchronization or transition frames which are not stream specific. The conclusion frame is presented at (243) and cleared by program synchronization segment (251). At time T3, the user could not have viewed frame (243) if the user had been presented with frame (244), due to the hierarchy of the system. Thus, it is safe for the interactive terminal to switch to data stream (102) at time T3. Now, the two possible conclusions have been presented to the user and the interactive terminal is presenting nonspecific program information segments in frame (261, 361). This clears up data stream (103) and allows the branch from frame (245, 345) to go to stream (103), rather than stream (104). Thus, the branch from frame (245) has been "folded" up to stream (103). Likewise, frame (261, 361) may be instructed to branch to stream (101) at time T4. This frees up a frame on stream (102) so that frame (248, 348) may be "folded" to stream (102) and frame (249, 349) may be "folded" to stream (103). Thus, the number of streams has been reduced from five to three. The value of this technique is the conservation in the number of required streams thereby preserving valuable channel capacity in a transmission system. In this case, only three channels would be necessary.

[0087] The concept of "folding" need not resemble a physical bending of a branch on the hierarchial tree diagram, but includes the juxtaposition of frames and provision of stream jumps to decrease the number of required data streams.

[0088] While Figure 7 discloses a very simple example, it will be clear to those skilled in the art that extremely complex interactive expert systems may be developed without a microprocessor to provide high levels of interactivity. For example, this type of system is applicable to financial analysis, document creation (i.e., wills, contracts, leases, etc.) or troubleshooting. The more streams of media that are available, the higher degree of parallelism and complex rule-base and overall expert system that becomes achievable.

[0089] Systems such as those described above may be implemented, for example, as point of sale kiosks. In a kiosk implementation, n channels of a program may be implemented on a videocassette which is contained in a videocassette player in the kiosk. A keypad, touch-screen or voice recognition technology on the face of the kiosk enables users to enter selections. Alternatively, the interactive program might be implemented as a how-to-program in a video on demand system.

[0090] In Table 3, a script is shown of an interactive expert system to help a person choose the proper tennis racket. Such a program might be used as a marketing tool in sporting goods stores, and the video portion of the program might include a celebrity to help the user select a racket. Due to the large number of factors which are involved in making the proper racket decision (which would potentially require a large number of channels or would be extremely long in length), a microprocessor is used to direct the storage of information in memory based upon the user responses. An algorithm is used to determine which racket is appropriate based upon the memory contents once all of the pertinent information has been gathered. Coding on the media tells the microprocessor to store the appropriate data as necessary. The microprocessor also directs switching between the channels as appropriate. It is important to note that this example can be implemented using the techniques discussed with reference to Example 1, without the need for using a microprocessor. For example, rather than storing the user's information in memory locations, the interactive program could branch to an entirely different set of data streams every time an input was necessary.

[0091] A generalized diagram of the frame locations and contents, similar to Figure 5, is shown for the second example in Figure 8, comprising Figures 8A, 8B, 8C, and 8D. As can be seen in the Figure 8 frame diagram, the system asks for the user's age at time T0, gender at time T1, experience at time T2, rating at time T3, hit level at time T4, frequency of play at time T5, and weight at time T6. At time T7, the racquet algorithm is executed and racquets are recommended at times T8 or T9. At time T10, the string tension is recommended. At time T11, a grip width is suggested based on the previous gender response. At T12, a second racquet is recommended based on the frequency of use.

Due to space constraints, Figure 8 shows an abbreviated version of the frame contents. A more descriptive depiction of this example is provided below in Table 3.

[0092] This example differs from Example 1 in that the user's interactive responses are letters A-D rather than yes/no responses 1 or 2. It is to be understood that any type of input, including dedicated keys, may be used. The microprocessor of this embodiment contains multiple memory locations, addresses #1-#4 to store information entered by the user for subsequent calculation.

[0093] Unlike Example 1, the command portion of the frames contain instructions related to changing channels and storing information in variables. In this example, the command portion is used throughout the presentation to instruct the microprocessor on the storage of variables and stream switching. Also, in this example the command portion of the frame instructs the microprocessor to "switch" to the same channel rather than "stay" on the same channel, where appropriate. The artisan will recognize that both commands accomplish the same result. As with Example #1, information included in the command portion is enclosed in brackets {}. Also, the data streams and frames may be further "folded" or encoded from the hierarchial tree diagram, although not specifically exemplified here.

[0094] The rule-base and hierarchial diagrams of this example are not shown since Table 3 and Figure 8 clearly depict the frame relationships.

TABLE 3:

Script of Frame Contents for Tennis Racquet Selection Example.				
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**
T'	... {switch to 101}	... {switch to 101}	... {switch to 101}	... {switch to 101}
T0	Hi, I'm Mr. Tennis Pro and I'm here to help you pick the proper tennis racquet. All you have to do is answer a few questions for me. I'll analyze your answers and recommend exactly what will be best for you. First, how old are you? Under 15 - input A 15-40- input B 41-60 - input C Over 60 - input D Answer now. {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	(unused)	(unused)	(unused)
T1	Thanks. I can now see that you are under 15 years old. Yo, it's never too soon to learn tennis. {Put +1 in memory #1) Are you male (Input A) or female (Input B)? Please Indicate. {if A, switch to 101, if B, switch to 102}	Thanks. I can now see that you are between 15 and 40 years old. You are therefore at the peak of your game. {Put 0 to memory #1} Are you male (Input A) or female (Input B)? Please indicate. {if A, switch to 101, if B, switch to 102}	Thanks. I can now see that you are between 41 and 60 years old. I started enjoying tennis the most after I turned 60. {Put +2 in memory #1} Are you male (Input A) or female (Input B)? Please indicate. {if A, switch to 101, if B, switch to 102}	Thanks. I can now see that you are over 60 years old. You know people play tennis into their 90's and beyond. {Put +4 in memory #1} Are you male (Input A) or female (Input B)? Please indicate. {if A, switch to 101, if B, switch to 102}

TABLE 3: (continued)

Script of Frame Contents for Tennis Racquet Selection Example.				
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**
T2	Thanks, sir. {Add 0 to memory #1; Put "X" in memory #2} How long have you been playing tennis? Less than 1 yr. -input A 1-3 years - Input B 3-5 years - Input C over 5 years - input D Please indicate {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	Thanks, madam. {Add +2 to memory #1; Put "Y" in memory #2} How long have you been playing tennis? Less than 1 yr. - input A 1-3 years - Input B 3-5 years - Input C over 5 years - input D Please indicate {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	(unused)	(unused)
T3	{Add +3 to memory #1} Oh, a newcomer. What type of player are you when it comes to ratings? Championship - Input D A - Input A B - Input B C - input C Please indicate. {if A, switch to 102, if B switch to 103, if C, switch to 104, if D, switch to 101}	{Add +2 to memory #1} 1 to 3 years. So you're pretty new to this. What type of player are you when it comes to ratings? Championship - Input D A - Input A B-Input B C - input C Please indicate. {if A, switch to 102, if B switch to 103, if C, switch to 104, if D, switch to 101}	{Add +1 to memory #1} 3 to 5 years. Oh you're just getting good. What type of player are you when it comes to ratings? Championship - Input D A - Input A B - Input B C - input C Please indicate. {if A, switch to 102, if B switch to 103, if C, switch to 104, if D, switch to 101}	{Add 0 to memory #1} Over 5 years. So you obviously enjoy tennis. What type of player are you when it comes to ratings? Championship - Input D A - Input A B - Input B C - input C Please indicate. {if A, switch to 102, if B switch to 103, if C, switch to 104, if D, switch to 101}
T4	{Add 0 to memory #1} Which of these describes the way you play best? Hit hard a lot - Input A Hit hard on occasion - Input B Rarely hit hard -Input C Never hit hard - Input D {if A, switch to 101, if B, switch to 102, if C switch to 103, if D switch to 104}	{Add 1 to memory #1} Which of these describes the way you play best? Hit hard a lot - Input A Hit hard on occasion - Input B Rarely hit hard -Input C Never hit hard -Input D {if A, switch to 101, if B, switch to 102, if C switch to 103, if D switch to 104}	{Add 3 to memory #1} Which of these describes the way you play best? Hit hard a lot - Input A Hit hard on occasion - Input B Rarely hit hard -Input C Never hit hard -Input D {if A, switch to 101, if B, switch to 102, if C switch to 103, if D switch to 104}	{Add 5 to memory #1} Which of these describes the way you play best? Hit hard a lot - Input A Hit hard on occasion - Input B Rarely hit hard - Input C Never hit hard -Input D {if A, switch to 101, if B, switch to 102, if C switch to 103, if D switch to 104}

TABLE 3: (continued)

Script of Frame Contents for Tennis Racquet Selection Example.				
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**
T5	{Add 0 to memory #1; Put 1 in memory #3} How often do you play? Once a week or less - Input A Twice a week -Input B Three times a week - Input C More than three times a week - Input D {if A switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	{Add +1 to memory #1; Put 2 in memory #3} How often do you play? Once a week or less - Input A Twice a week -Input B Three times a week - Input C More than three times a week - Input D {if A switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	{Add +2 to memory #1; Put 3 in memory #3} How often do you play? Once a week or less - Input A Twice a week - Input B Three times a week - Input C More than three times a week - Input D {if A switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104.}	{Add +3 to memory #1; Put 4 in memory #3} How often do you play? Once a week or less - Input A Twice a week - Input B Three times a week - Input C More than three times a week - Input D {if A switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}
T6	{Add +2 to memory #1: Put a "J" in memory #4} Hey, once a week is not enough. Get out there and play more. How much do you weigh? 25-100 lbs. - Input A 101-150 lbs.-Input B 151-200 lbs. -Input C Over 200 lbs. -Input D {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	{Add +1 to memory #1; Put a "J" in in memory #4} Hey, twice a week is not enough. Try to play 3 times a week. How much do you weigh? 25-100 lbs. - Input A 101-150 lbs.-Input B 151-200 lbs. -Input C Over 200 lbs. -Input D {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	{Add +1 to memory #1: Put a "K" in memory #4} Three times a week is pretty good, but four times is better. How much do you weigh? 25-100 lbs.-Input A 101-150 lbs. -Input B 151-200 lbs.-Input C Over 200 lbs. -Input D {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}	{Add 0 to memory #1; Put "K" in memory #4} Great. This is superb. The more you play the better and healthier you get. How much do you weigh? 25-100 lbs. -Input A 101-150 lbs. -Input B 151-200 lbs. -Input C Over 200 lbs. -Input D {if A, switch to 101, if B, switch to 102, if C, switch to 103, if D, switch to 104}
T7	(Add +2 to memory #1} I now have all your input and can evaluate which type of racquet, grip, and string tension is best for you. {If memory #1 ≥ +26, switch to 102; if memory #1 is ≥ 17 and ≤ 25 then switch to 103; if memory #1 ≥14 and ≤ 16 then switch to 104; otherwise switch to 101}	{Add + 1 to memory #1} I now have all your input and can evaluate which type of racquet, grip, and string tension is best for you. {If memory #1 ≥ +26, switch to 102; if memory #1 is ≥ 17 and ≤ 25 then switch to 103; if memory #1 ≥14 and ≤ 16 then switch to 104; otherwise switch to 101}	{Add 0 to memory #1} I now have all your input and can evaluate which type of racquet, grip, and string tension is best for you. {If memory #1 ≥ +26, switch to 102; if memory #1 is ≥ 17 and ≤ 25 then switch to 103: if memory #1 ≥14 and ≤ 16 then switch to 104; otherwise switch to 101}	{Add +4 to memory #1} I now have all your input and can evaluate which type of racquet, grip, and string tension is best for you. {If memory #1 ≥ +26, switch to 102; if memory #1 is ≥ 17 and ≤ 25 then switch to 103; if memory #1 ≥14 and ≤ 16 then switch to 104; otherwise switch to 101}
T8	The following racquet will be the most appropriate model for you. {If memory #1 ≤ 13 and ≥ 10 then switch to 102; If memory # 1 ≥ 9 and ≤ 5 then switch to 103; If memory #1 ≤ 4 then switch to 104;}	I recommend the Zenith Model 206 racquet. {switch to 101}	I recommend the Zenith Model 208 racquet. {switch to 101)	I recommend the Zenith Model 210 racquet. {switch to 101}

TABLE 3: (continued)

Script of Frame Contents for Tennis Racquet Selection Example.				
Time	**Stream 101**	**Stream 102**	**Stream 103**	**Stream 104**
T9	You will find the above racquet most appropriate to your needs. {if memory #3 = 1 then switch to 101; if memory #3 = 2 then switch to 102; if memory #3 = 3 then switch to 103; if memory #3 = 4 then switch to 104}	I recommend the Zenith Model 212. {if memory #3 = 1 then switch to 101; if memory #3 = 2 then switch to 102; if memory #3 = 3 then switch to 103; if memory #3 = 4 then switch to 104}	I recommend the Zenith Model 214. {if memory #3 = 1 then switch to 101; If memory #3 = 2 then switch to 102; if memory #3 = 3 then switch to 103; If memory #3 = 4 then switch to 104}	I recommend the Zenith Model 216. {if memory #3 = 1 then switch to 101; if memory #3 = 2 then switch to 102; if memory #3 = 3 then switch to 103; if memory #3 = 4 then switch to 104}
T10	The string tension should be set to 43 pounds. {if memory #2 = "X" then switch to 101; if memory #2 = "Y" then switch to 102}	The string tension should be set to 50 pounds. {if memory #2 = "X" then switch to 101; if memory #2 = "Y" then switch to 102}	The string tension should be set to 55 pounds. {if memory #2 = "X" then switch to 101; if memory #2 = "Y" then switch to 102}	The string tension should be set to 65 pounds. {if memory #2 = "X" then switch to 101; if memory #2 = "Y" then switch to 102}
T11	Since you are male, get the "widegrip model for men. {If memory #4 = "J" then switch to 101; if memory #4 = "K" then switch to 102}	Since you are female, get the slender grip model for women. {If memory #4 = "J" then switch to 101; if memory #4 = "K" then switch to 102}	(unused)	(unused)
T12	Since you play at least 3 times a week, you may wish to buy two identical racquets in case you break a string. This entitles you to a 15% discount on the second racquet. It has been a pleasure helping you to select a tennis racket. Have a good day. {switch to 101}	Based on the number of times per week that you play, one racquet should be sufficient. If you take proper care of it, it should last about 2 years. It has been a pleasure helping you to select a tennis racket. Have a good day. {switch to 101}	(unused)	(unused)

[0095] Although the present invention has been described in detail with respect to certain embodiments and examples, variations and modifications exist which are within the scope of the present invention as defined in the following claims.

Claims

1. A method for providing expert based interactive programs to an interactive terminal such that a high level of conversational responsiveness and interactivity is achieved, the method comprising:

   defining (10) a goal for the expert based program;
   developing rules (12) leading to the defined goal, the rules comprising at least one premise and a conclusion whereby the rules are related hierarchically to one another in that a conclusion of at least one of the rules is a premise of another rule;

forming queries (13), each query corresponding to a premise which requires a user response to determine the existence of the premise;
mapping the queries and rules into a plurality of data streams to generate an interactive program (15), the plurality of data streams containing frames, the frames being time-synchronized between data streams, and at least one frame (200) containing an information portion (210) and a command portion (220); and
storing the data streams (16) in an interactive storage medium such that the expert based interactive program is retrievable for provision to an interactive terminal.

2. A method as claimed in Claim 1, further comprising:

translating the queries and rules into a hierarchical tree diagram (14) in which the rules are logically organized and related to one another by using branches;
mapping the hierarchical tree diagram into the plurality of data streams (101-105) to generate the interactive program, the hierarchical tree diagram being mapped into the plurality of data streams in a predetermined sequence, and each data-stream having one or more frames (200) related in content, wherein the frames represent and completely implement the branches of the hierarchical flow diagram.

3. A method as claimed in Claim 1 or Claim 2, wherein the expert based interactive program is provided to an interactive terminal using one or more dynamically allocated data streams in order to conserve channel capacity, the method further comprising:

identifying a number of data streams (101) to be transmitted during a frame interval (T0-T1), the number corresponding to the number of time-synchronized frames during the frame interval which contain an information portion and a command portion;
transmitting the identified number of data streams dynamically during a current frame interval over an interactive medium to an interactive terminal, wherein only those data streams having a frame with an information portion and a command portion are transmitted during the current frame interval.

4. A method as claimed in any preceding claim, wherein some of the frames contain information portions and command portions, and others of the frames contain program synchronization segments, the method further comprising:

folding frames containing information portions and command portions from at least one data stream into frames of other data streams containing only program synchronization segments, wherein the total number of required data streams is reduced to include at least one compacted data stream; and
storing the reduced number of data streams, including the compacted data stream, in the interactive storage medium.

5. A method for receiving an expert based interactive program at an interactive terminal, the interactive program comprising a plurality of data streams (101-105), the method comprising:

receiving the plurality of data streams, each data stream having a plurality of time-synchronized frames (200), wherein the frames contain embedded expert system rules and queries, the rules being hierarchically related to one another and comprising at least one premise and a conclusion;
selecting a frame from a single data stream out of the plurality of provided data streams using a signal selector (3), whereby the selected frame comprises a query;
presenting the query to a user through an interactive output device (9);
receiving a user entry in response to the presented query;
determining a next frame hierarchically related to the selected frame, the next frame determined being based on the received user entry and the selected frame; and
obtaining the next frame using the signal selector, whereby the next frame contains another query or a conclusion to an expert system rule.

6. A method as claimed in Claim 5, wherein the step of obtaining the next frame comprises:

interpreting the received user entry and the selected frame to ascertain the location of the next frame;
choosing a data stream which corresponds to the interpreted location, where the selected data stream is chosen from the plurality of data streams (101-105) including the single data stream.

7. An interactive terminal for receiving an expert based interactive program, said interactive terminal comprising:

means (2) for receiving one or more data streams, each data stream having a plurality of time-synchronized frames comprising premises, queries, and conclusions which represent rules of a hierarchical rule-base, the hierarchical rule-base formed in that at least one premise of one rule is a conclusion of another rule;
a signal selector (3) for selecting a frame out of the provided data streams, wherein the selected frame comprises instructions indicating a query;
means (7) for receiving the selected frame and generating an interactive query based on the instructions of the received frame;
an interactive output device (9) for presenting the generated query to a user;
means (6) for receiving an entry from the user in response to the generated interactive query; and
means using the signal selector to obtain a next frame from the provided data stream, where the next frame contains another query or a conclusion to an expert system rule.

8. An interactive terminal as claimed in Claim 7, further comprising:

storage means (5) for storing data streams of interactive data, the stored interactive data being comprised of time-synchronized frames comprising premises, queries, and conclusions which represent rules of a hierarchical rule-base, the hierarchical rule-base formed in that at least one premise of one rule is a conclusion of another rule;
said means (7) receiving either a frame selected by said signal selector (3), or a frame from said storage means (5), and generating the interactive query based on the instructions of the received frame.

9. An interactive terminal as claimed in Claim 7 or Claim 8, wherein said means (7) for generating a query comprises a storage means for storing at least one or more queries.

10. An interactive terminal as claimed in any of Claims 7 to 9, further comprising a processor, connected to said receiving means (7) for interpreting the received frame and executing the instructions contained in the received frame.

Patentansprüche

1. Verfahren zum Bereitstellen von interaktiven Programmen auf Expertenbasis an ein interaktives Terminal, so dass ein hohes Niveau an Dialogansprechbarkeit und Interaktivität erreicht wird, wobei das Verfahren umfasst:

Definieren (10) eines Ziels für das Programm auf Expertenbasis;
Entwickeln von Regeln (12), die zu dem definierten Ziel führen, wobei die Regeln mindestens eine Voraussetzung und ein Ergebnis umfassen, wodurch die Regeln sich hierarchisch aufeinander beziehen, dadurch, dass ein Ergebnis mindestens einer der Regeln eine Voraussetzung einer anderen Regel ist;
Bilden von Anfragen (13), wobei jede Anfrage einer Voraussetzung entspricht, die eine Benutzerantwort erfordert, um die Existenz der Voraussetzung zu bestimmen;
Abbilden der Anfragen und Regeln in eine Mehrzahl von Datenströmen zum Erzeugen eines interaktiven Programms (15), wobei die genannte Mehrzahl an Datenströmen Rahmen enthält, wobei die Rahmen zwischen den Datenströmen zeitlich synchronisiert sind und mindestens ein Rahmen (200) einen Informationsabschnitt (210) und einen Befehlsabschnitt (220) enthält; und
Speichern der Datenströme (16) in einem interaktiven Speichermedium, so dass das interaktive Programm auf Expertenbasis zur Bereitstellung an ein interaktives Terminal wiedergewonnen werden kann.

2. Verfahren nach Anspruch 1, das weiterhin umfasst:

Übersetzen der Anfragen und Regeln in ein hierarchisches Baumdiagramm (14), in welchem die Regeln logisch organisiert sind und sich aufeinander beziehen durch Verwendung von Verzweigungen;
Abbilden des hierarchischen Baumdiagramms in die Mehrzahl von Datenströmen (101-105) um das interaktive Programm zu erzeugen, wobei das hierarchische Baumdiagramm in die Mehrzahl von Datenströme in einer vorbestimmten Sequenz abgebildet wird, und jeder Datenstrom einen oder mehr Rahmen (200) aufweist, die inhaltlichen Bezug haben, wobei die Rahmen die Verzweigungen des hierarchischen Flussdiagramms darstellen und vollständig realisieren.

3. Verfahren nach Anspruch 1 oder 2, wobei das interaktive Programm auf Expertenbasis einem interaktiven Terminal bereitgestellt wird unter Verwendung von einem oder mehr dynamisch zugeordneten Datenströmen, um Kanalkapazität zu erhalten, wobei das Verfahren weiterhin umfasst:

Identifizieren einer Anzahl von Datenströmen (101), die während eines Rahmenintervalls (T0-T1) zu übertragen sind, wobei die Anzahl der Anzahl an zeitlich synchronisierten Rahmen während des Rahmenintervalls entspricht, welche einen Informationsabschnitt und einen Befehlsabschnitt enthalten;
dynamisches Übertragen der identifizierten Anzahl an Datenströmen während eines aktuellen Rahmenintervalls über ein interaktives Medium an ein interaktives Terminal, wobei nur jene Datenströme mit einem Rahmen mit einem Informationsabschnitt und einem Befehlsabschnitt während des aktuellen Rahmenintervalls übertragen werden.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei einige der Rahmen Informationsabschnitte und Befehlsabschnitte enthalten und andere der Rahmen Programm-Synchronisationssegmente enthalten, wobei das Verfahren weiterhin umfasst:

Falten von Rahmen, die Informationsabschnitte und Befehlsabschnitte enthalten, von mindestens einem Datenstrom in Rahmen von anderen Datenströmen, die nur Programmsynchronisationssegmente, wobei die gesamte Anzahl an erforderlichen Datenströmen reduziert ist, so dass mindestens ein verdichteter Datenstrom beinhaltet ist; und
Speichern der reduzierten Anzahl an Datenströmen, einschließlich dem verdichteten Datenstrom, in dem interaktiven Speichermedium.

5. Verfahren zum Empfangen eines interaktiven Programms auf Expertenbasis bei einem interaktiven Terminal, wobei das interaktive Programm eine Mehrzahl von Datenströmen (101-105) hat, und das Verfahren umfasst:

Empfangen der Mehrzahl von Datenströmen, wobei jeder Datenstrom eine Mehrzahl von zeitlich synchronisierten Rahmen (200) hat, wobei die Rahmen eingebettete Expertensystemregeln und Anfragen enthalten, wobei die Regeln hierarchisch in Bezug zueinander stehen und mindestens eine Voraussetzung und ein Ergebnis umfassen;
Auswählen eines Rahmens von einem einzelnen Datenstrom aus der Mehrzahl von bereitgestellten Datenströmen unter Verwendung eines Signalselektors (3), wodurch der gewählte Rahmen eine Anfrage umfasst;
Präsentieren der Anfrage an einen Benutzer durch eine interaktive Ausgabevorrichtung (9);
Empfangen einer Benutzereingabe in Reaktion auf die präsentierte Anfrage;
Bestimmen eines nächsten Rahmens, der in hierarchischem Bezug zu dem gewählten Rahmen steht, wobei der nächste bestimmte Rahmen auf der erhaltenen Benutzereingabe und dem gewählten Rahmen basiert; und
Erhalten des nächsten Rahmens unter Verwendung des Signalselektors, wodurch der nächste Rahmen eine weitere Anfrage oder ein Ergebnis auf eine Expertensystemregel enthält.

6. Verfahren nach Anspruch 5, wobei der Schritt des Erhaltens des nächsten Rahmens umfasst:

Interpretieren der erhaltenen Benutzereingabe und des gewählten Rahmens zum Feststellen des Orts des nächsten Rahmens;
Wählen eines Datenstroms, welcher der interpretierten Stelle entspricht, wo der gewählte Datenstrom aus der Mehrzahl von Datenströmen (101-105) einschließlich dem einzelnen Datenstrom ausgewähltwird.

7. Interaktives Terminal zum Empfangen eines interaktiven Programms auf Expertenbasis, wobei das interaktive Terminal umfasst:

eine Einrichtung (2) zum Empfangen von einem oder mehr Datenströmen, wobei jeder Datenstrom eine Mehrzahl von zeitlich synchronisierten Rahmen aufweist, die Voraussetzungen, Anfragen und Ergebnisse umfassen, welche Regeln einer hierarchischen Regelbasis darstellen, wobei die hierarchische Regelbasis dadurch gebildet wird, dass mindestens eine Voraussetzung einer Regel ein Ergebnis einer anderen Regel ist;
einen Signalselektor (3) zum Wählen eines Rahmens aus den bereitgestellten Datenströmen, wobei der gewählte Rahmen Instruktionen aufweist, die eine Anfrage darstellen;
eine Einrichtung (7) zum Empfangen des gewählten Rahmens und Erzeugen einer interaktiven Anfrage auf der Basis der Instruktionen des erhaltenen Rahmens,
eine interaktive Ausgabevorrichtung (9) zur Darstellung der erzeugten Anfrage an einen Benutzer;

eine Einrichtung (6) zum Empfangen eines Eintrags von dem Benutzer in Reaktion auf die erzeugte interaktive Anfrage; und
eine Einrichtung, die den Signalselektor verwendet, um den nächsten Rahmen von dem bereit gestellten Datenstrom zu erhalten, wobei der nächste Rahmen eine weitere Anfrage oder ein Ergebnis zu einer Expertensystemregel enthält.

8. Interaktives Terminal nach Anspruch 7, welches weiterhin umfasst:

eine Speichereinrichtung (5) zum Speichern von Datenströmen von interaktiven Daten, wobei die interaktiven Daten aus zeitlich synchronisierten Rahmen bestehen, die Voraussetzungen, Anfragen und Ergebnisse aufweisen, die Regeln einer hierarchischen Regelbasis darstellen, wobei die hierarchische Regelbasis so gebildet ist, dass mindestens eine Voraussetzung einer Regel ein Ergebnis einer anderen Regel ist;

wobei die Empfangseinrichtung (7) entweder einen Rahmen empfängt, der von dem Signalselektor (3) gewählt wurde, oder einen Rahmen von der Speichereinrichtung (5), und die interaktive Anfrage auf der Basis der Instruktionen des empfangenen Rahmens erzeugt.

9. Interaktives Terminal nach Anspruch 7 oder 8, wobei die Einrichtung (7) zum Erzeugen einer Anfrage eine Speichereinrichtung umfasst zum Speichern mindestens einer oder mehr Anfragen.

10. Interaktives Terminal nach einem der Ansprüche 7 bis 9, welches weiterhin einen Prozessor aufweist, der mit der Empfangseinrichtung (7) verbunden ist zum Interpretieren des empfangenen Rahmens und Ausführen der Instruktionen, die in dem empfangenen Rahmen enthalten sind.

Revendications

1. Procédé d'envoi de programmes interactifs basés sur un système expert à un terminal interactif, de telle sorte qu'un haut niveau de réponse conversationnelle et d'interactivité soit obtenu, le procédé comprenant les étapes qui consistent à :

définir (10) un but pour le programme basé sur un système expert ;
développer des règles (12) conduisant au but défini, les règles comprenant au moins une prémisse et une conclusion, par lesquelles les règles sont associées entre elles de manière hiérarchique, par le fait qu'une conclusion d'au moins l'une des règles constitue une prémisse d'une autre règle ;
former des requêtes (13), chaque requête correspondant à une prémisse qui nécessite une réponse d'utilisateur pour déterminer l'existence de la prémisse ;
cartographier les requêtes et les règles en une pluralité de flux de données de manière à générer un programme interactif (15), la pluralité de flux de données contenant des trames, les trames étant synchronisées dans le temps entre les flux de données, et au moins une trame (200) contenant une partie informations (210) et une partie commandes (220);
stocker les flux de données (16) sur un support de stockage interactif, de telle sorte que le programme interactif basé sur un système expert puisse être récupéré pour être envoyé à un terminal interactif.

2. Procédé selon la revendication 1, comprenant, en outre, les étapes qui consistent à :

transcrire les requêtes et les règles en une structure arborescente hiérarchique (14) dans laquelle les règles sont organisées et associées les unes aux autres de manière logique, à l'aide de branches ;
cartographier la structure arborescente hiérarchique en la pluralité de flux de données (101-105) de manière à générer le programme interactif, la structure arborescente hiérarchique étant cartographiée en la pluralité de flux de données suivant une séquence prédéterminée, et chaque flux de données ayant une ou plusieurs trames (200) dont les contenus respectifs sont associés entre eux, où les trames représentent et implémentent complètement les branches de la structure arborescente hiérarchique.

3. Procédé selon la revendication 1 ou la revendication 2, dans lequel le programme interactif basé sur un système expert est envoyé à un terminal interactif à l'aide d'un ou plusieurs flux de données alloués de manière dynamique, afin de conserver la capacité des canaux, le procédé comprenant, en outre, les étapes qui consistent à :

identifier un certain nombre de flux de données (101) à transmettre pendant un intervalle de trame (T0-T1), ce nombre correspondant au nombre de trames, synchronisées dans le temps pendant l'intervalle de trame, qui contiennent une partie informations et une partie commandes ;
transmettre le nombre de flux de données identifié, de manière dynamique, pendant un intervalle de trame en cours sur un support interactif, à un terminal interactif, où seuls les flux de données qui ont une trame ayant une partie informations et une partie commandes sont transmis pendant l'intervalle de trame en cours.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel certaines des trames contiennent des parties informations et des parties commandes, et les autres contiennent des segments de synchronisation de programme, le procédé comprenant, en outre, les étapes qui consistent à :

incorporer les trames contenant des parties informations et des parties commandes, provenant d'au moins un flux de données, dans des trames d'autres flux de données contenant uniquement des segments de synchronisation de programme, le nombre total de flux de données requis étant réduit pour comprendre au moins un flux de données compacté ; et
stocker le nombre de flux de données réduit, comprenant le flux de données compactées, sur le support de stockage interactif.

5. Procédé de réception d'un programme interactif basé sur un système expert au niveau d'un terminal interactif, le programme interactif comprenant une pluralité de flux de données (101-105), le procédé comprenant les étapes qui consistent à:

recevoir la pluralité de flux de données, chaque flux de données ayant une pluralité de trames (200) synchronisées dans le temps, où les trames contiennent des règles et des requêtes de système expert intégrées, les règles étant associées de manière hiérarchique les unes aux autres et comprenant au moins une prémisse et une conclusion ;
sélectionner une trame dans un seul flux de données de la pluralité de flux de données envoyés, à l'aide d'un sélecteur de signal (3), où la trame sélectionnée comprend une requête ;
présenter la requête à un utilisateur par l'intermédiaire d'un dispositif de sortie interactif (9);
recevoir une entrée d'utilisateur en réponse à la requête présentée ;
déterminer une trame suivante, associée de manière hiérarchique à la trame sélectionnée, la trame suivante déterminée étant fonction de l'entrée d'utilisateur reçue et de la trame sélectionnée ; et
obtenir la trame suivante à l'aide du sélecteur de signal, la trame suivante contenant une autre requête ou une conclusion d'une règle de système expert.

6. Procédé selon la revendication 5, dans lequel l'étape consistant à obtenir la trame suivante comprend les opérations qui consistent à:

interpréter l'entrée d'utilisateur reçue et la trame sélectionnée pour s'assurer de l'emplacement de la trame suivante ;
choisir un flux de données qui correspond à l'emplacement interprété, le flux de données sélectionné étant choisi parmi la pluralité de flux de données (101-105) comprenant le flux de données unique.

7. Terminal interactif destiné à recevoir un programme interactif basé sur un système expert, ledit terminal interactif comprenant:

des moyens (2) pour recevoir un ou plusieurs flux de données, chaque flux de données ayant une pluralité de trames synchronisées dans le temps comprenant des prémisses, des requêtes, et des conclusions, qui représentent des règles d'une base de règles hiérarchique, la base de règles hiérarchique étant formée de telle sorte qu'au moins une prémisse d'une règle constitue une conclusion d'une autre règle ;
un sélecteur de signal (3) pour sélectionner une trame parmi les flux de données envoyés, où la trame sélectionnée comprend des instructions indiquant une requête ;
des moyens (7) pour recevoir la trame sélectionnée et générer une requête interactive en fonction des instructions de la trame reçue ;
un dispositif de sortie interactif (9) pour présenter la requête générée à un utilisateur ;
des moyens (6) pour recevoir une entrée d'utilisateur, en réponse à la requête interactive générée ; et
des moyens utilisant le sélecteur de signal pour obtenir la trame suivante à partir du flux de données reçu, la trame suivante contenant une autre requête ou une conclusion d'une règle de système expert.

8. Terminal interactif selon la revendication 7, comprenant, en outre :

des moyens de stockage (5) pour stocker des flux de données interactives, les données interactives stockées étant constituées de trames synchronisées dans le temps comprenant des prémisses, des requêtes, et des conclusions, qui représentent des règles d'une base de règles hiérarchique, la base de règles hiérarchique étant formée de telle sorte qu'au moins une prémisse d'une règle constitue une conclusion d'une autre règle ; lesdits moyens (7) pour recevoir une trame sélectionnée par ledit sélecteur de signal (3), ou bien une trame provenant desdits moyens de stockage (5), et générer la requête interactive en fonction des instructions de la trame reçue.

9. Terminal interactif selon la revendication 7 ou la revendication 8, dans lequel lesdits moyens (7) pour générer une requête comprennent des moyens de stockage pour stocker au moins une ou plusieurs requêtes.

10. Terminal interactif selon l'une quelconque des revendications 7 à 9, comprenant, en outre, un processeur, connecté auxdits moyens de réception (7) pour interpréter la trame reçue et exécuter les instructions contenues dans la trame reçue.

FIGURE 1

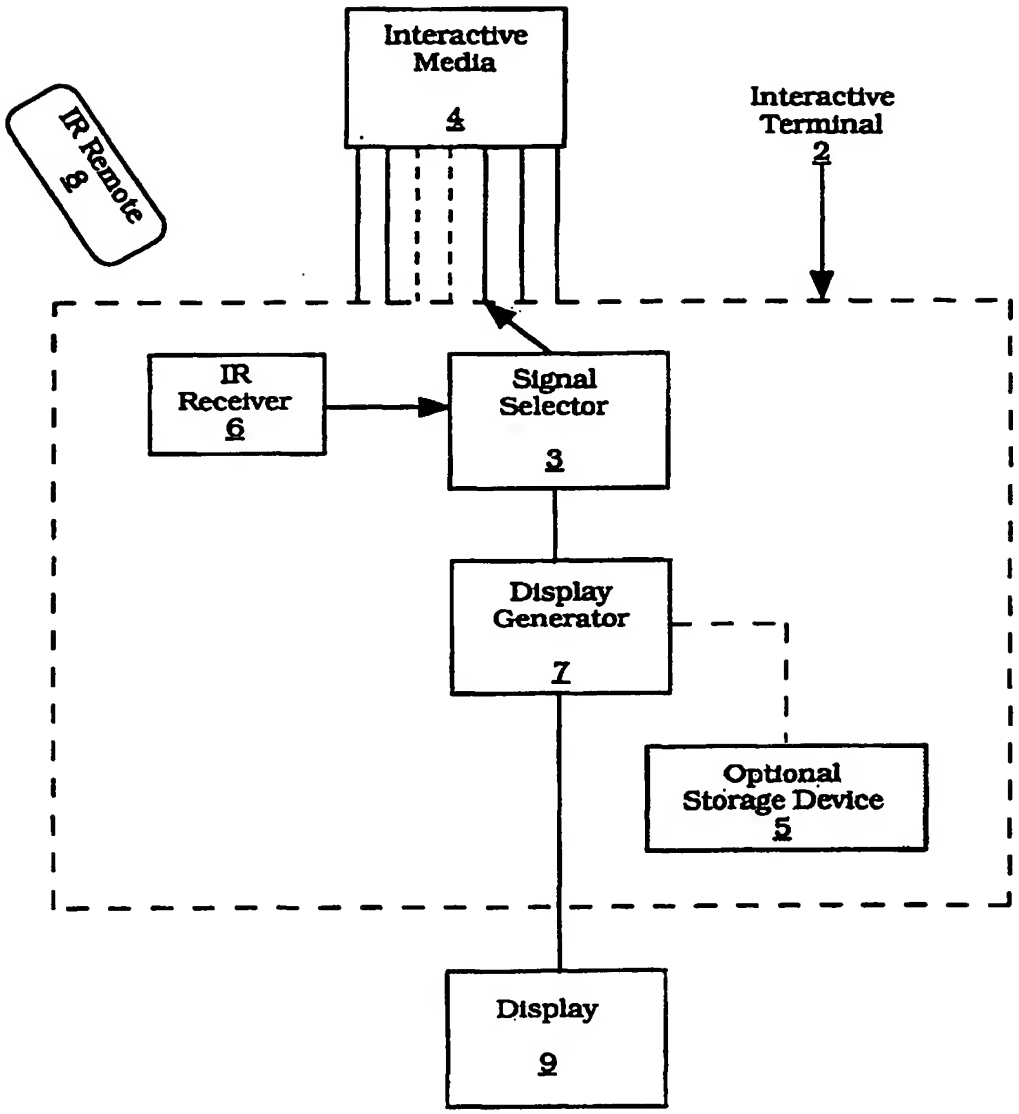
Interactive Media
4
Interactive Terminal
2
IR Remote
8
IR Receiver
6
Signal Selector
3
Display Generator
7
Optional Storage Device
5
Display
9

FIGURE 2

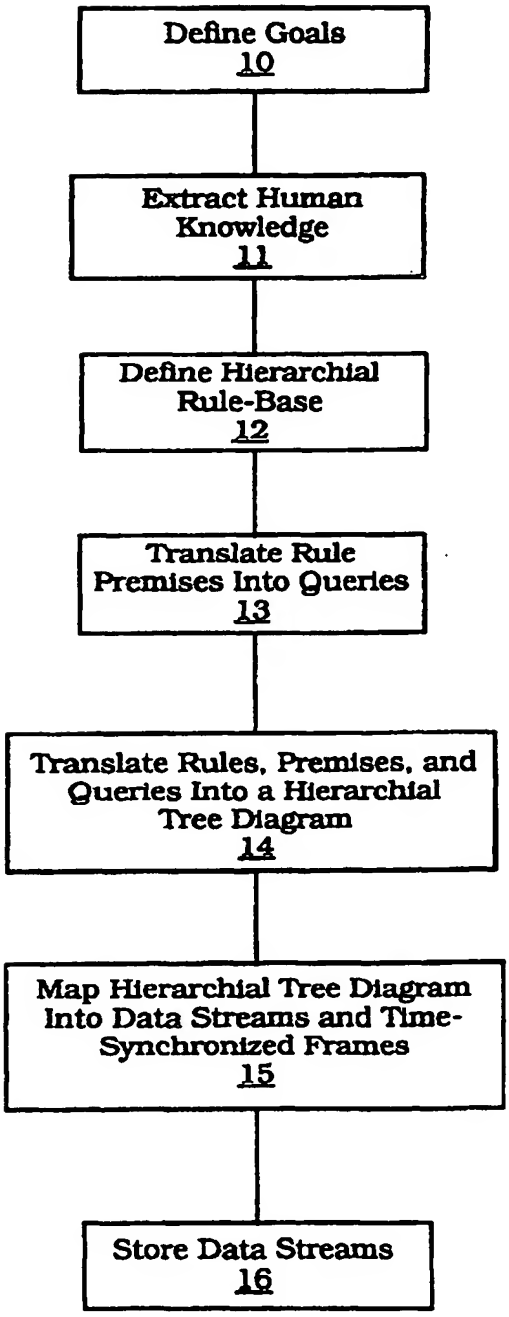
Define Goals
10
Extract Human Knowledge
11
Define Hierarchial Rule-Base
12
Translate Rule Premises Into Queries
13
Translate Rules, Premises, and Queries Into a Hierarchial Tree Diagram
14
Map Hierarchial Tree Diagram Into Data Streams and Time-Synchronized Frames
15
Store Data Streams
16

FIGURE 3

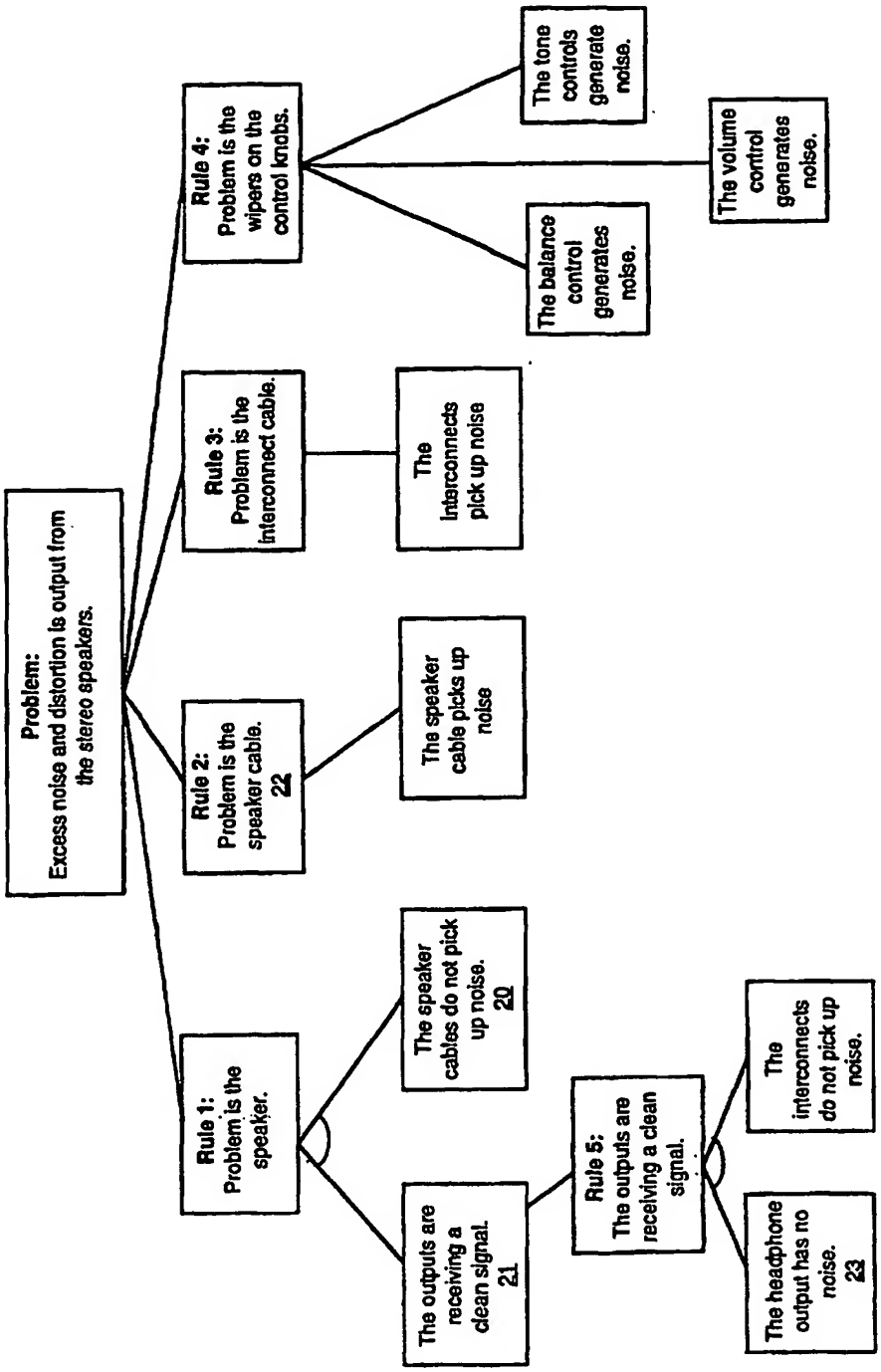
Problem:
Excess noise and distortion is output from the stereo speakers.
Rule 1:
Problem is the speaker.
The speaker cables do not pick up noise.
20
The outputs are receiving a clean signal.
21
Rule 5:
The outputs are receiving a clean signal.
The interconnects do not pick up noise.
The headphone output has no noise.
23
Rule 2:
Problem is the speaker cable.
22
The speaker cable picks up noise
Rule 3:
Problem is the interconnect cable.
The interconnects pick up noise
Rule 4:
Problem is the wipers on the control knobs.
The tone controls generate noise.
The volume control generates noise.
The balance control generates noise.

FIGURE 4

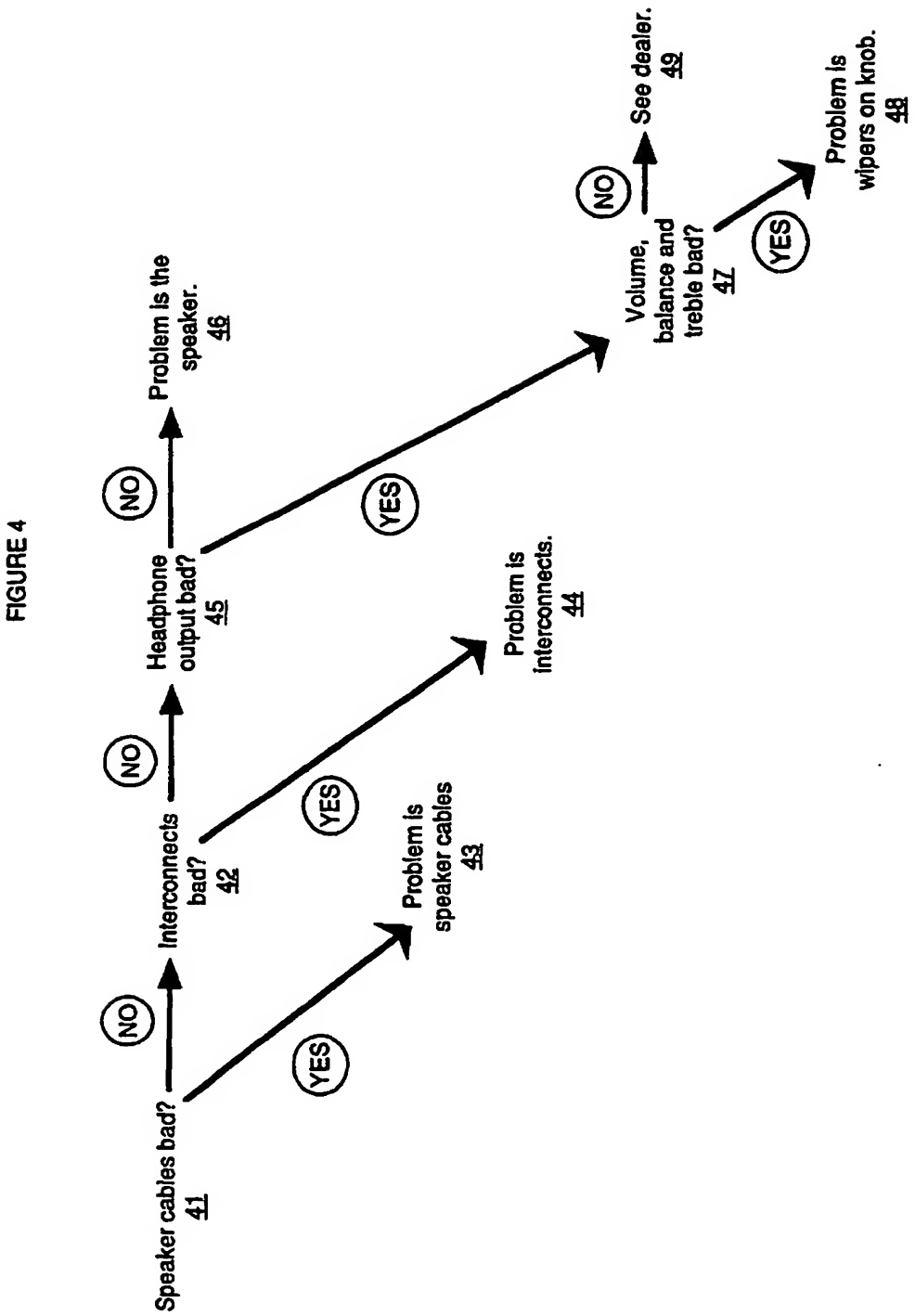
Speaker cables bad? 41
NO
YES
Problem is speaker cables 43
Interconnects bad? 42
NO
YES
Problem is interconnects. 44
Headphone output bad? 45
NO
YES
Problem is the speaker. 46
Volume, balance and treble bad? 47
NO
YES
See dealer. 49
Problem is wipers on knob. 48

FIGURE 5

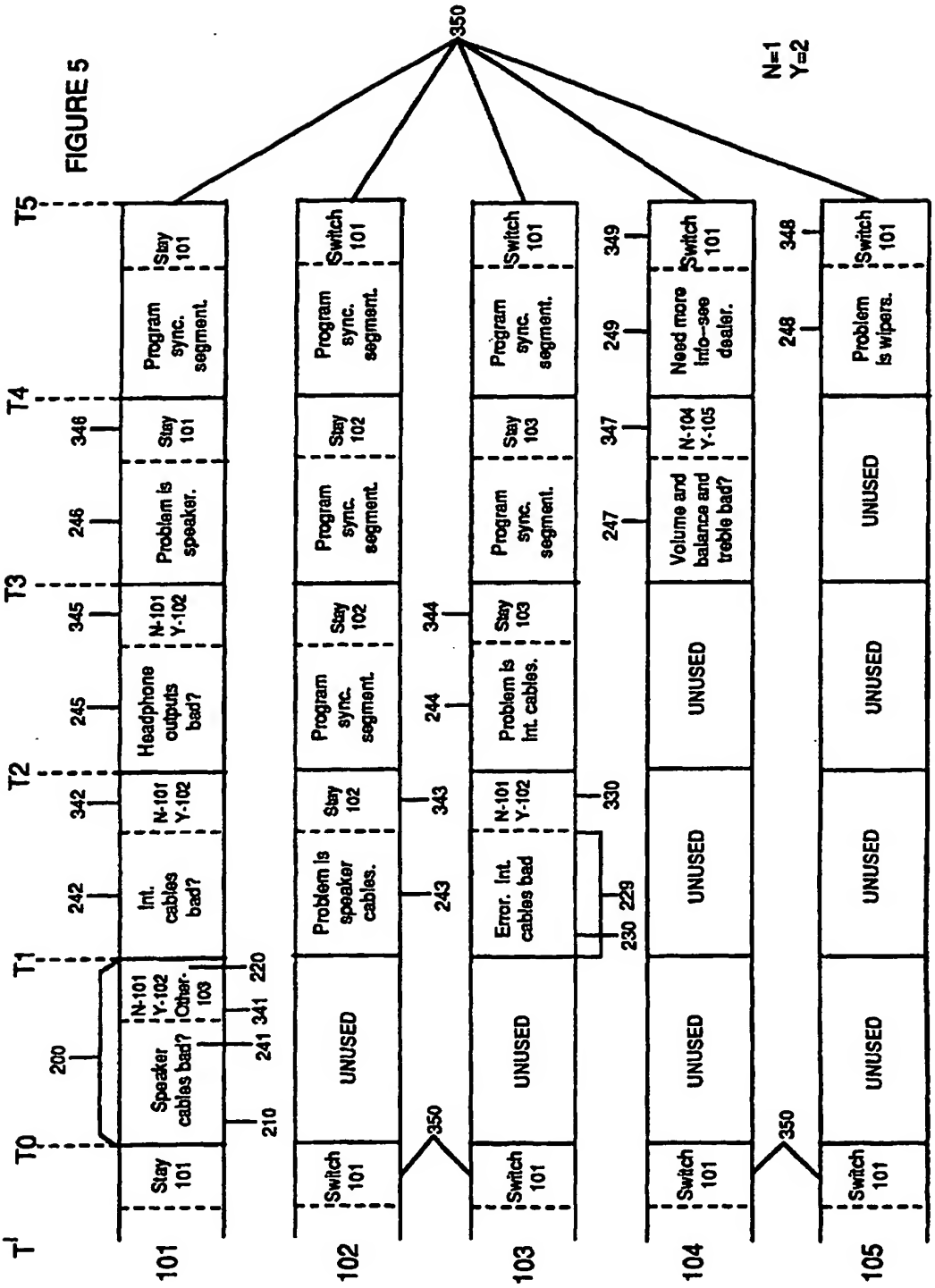
T'
T0
T1
T2
T3
T4
T5
101
102
103
104
105
Stay 101
Speaker cables bad?
N-101 Y-102 Other-103
Int. cables bad?
N-101 Y-102
Headphone outputs bad?
N-101 Y-102
Problem is speaker.
Stay 101
Program sync. segment.
Stay 101
200
210
220
241
242
341
342
345
246
346
Switch 101
UNUSED
Problem is speaker cables.
Stay 102
Program sync. segment.
Stay 102
Program sync. segment.
Stay 102
Switch 101
350
243
343
245
345
246
346
Switch 101
Error. Int. cables bad
N-101 Y-102
Problem is Int. cables.
Stay 103
Program sync. segment.
Stay 103
Program sync. segment.
Stay 103
Switch 101
350
230
330
244
344
247
347
249
349
Switch 101
UNUSED
UNUSED
Volume and balance and treble bad?
N-104 Y-105
Need more info--see dealer.
Switch 101
350
229
247
347
248
348
Switch 101
UNUSED
UNUSED
UNUSED
UNUSED
Problem is wipers.
Switch 101
350
N=1
Y=2

FIGURE 6

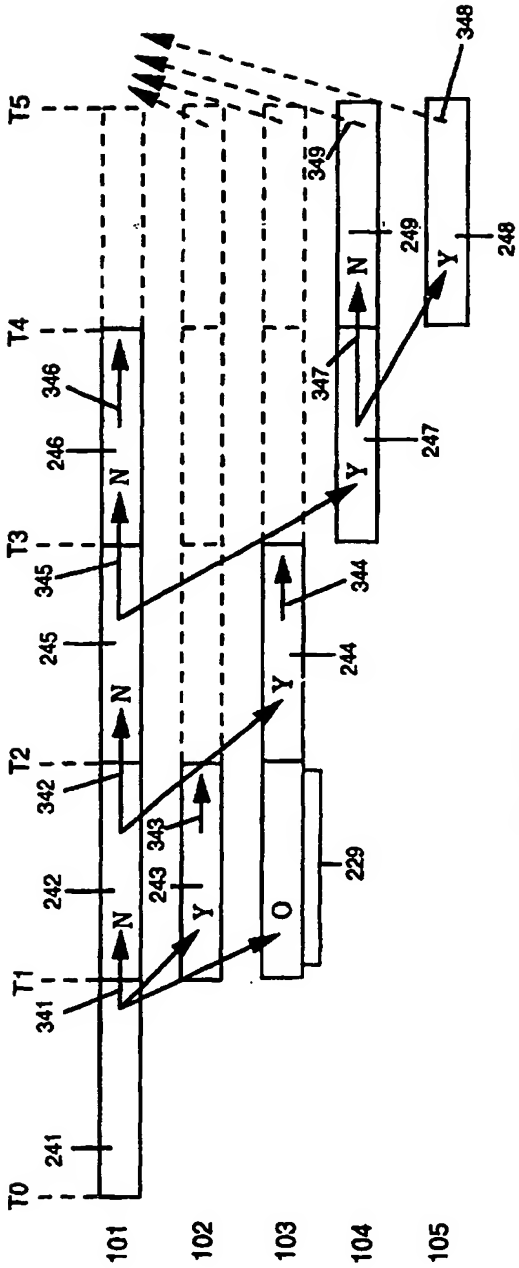

FIGURE 7

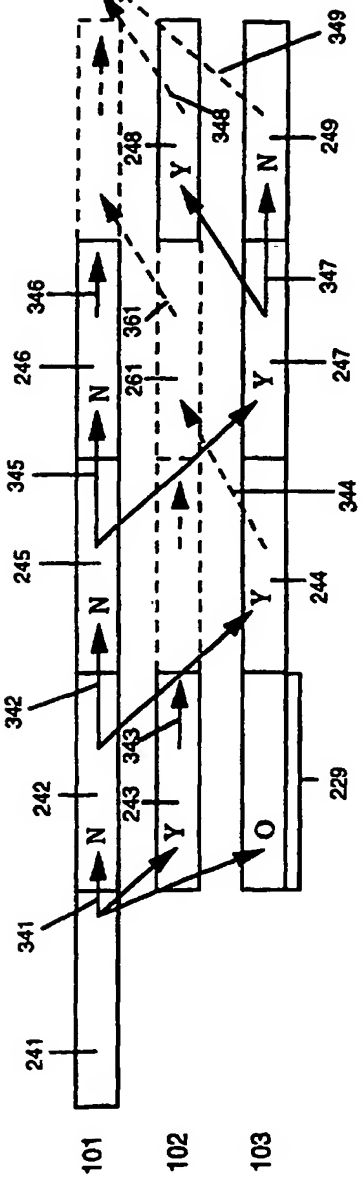

FIGURE 8A

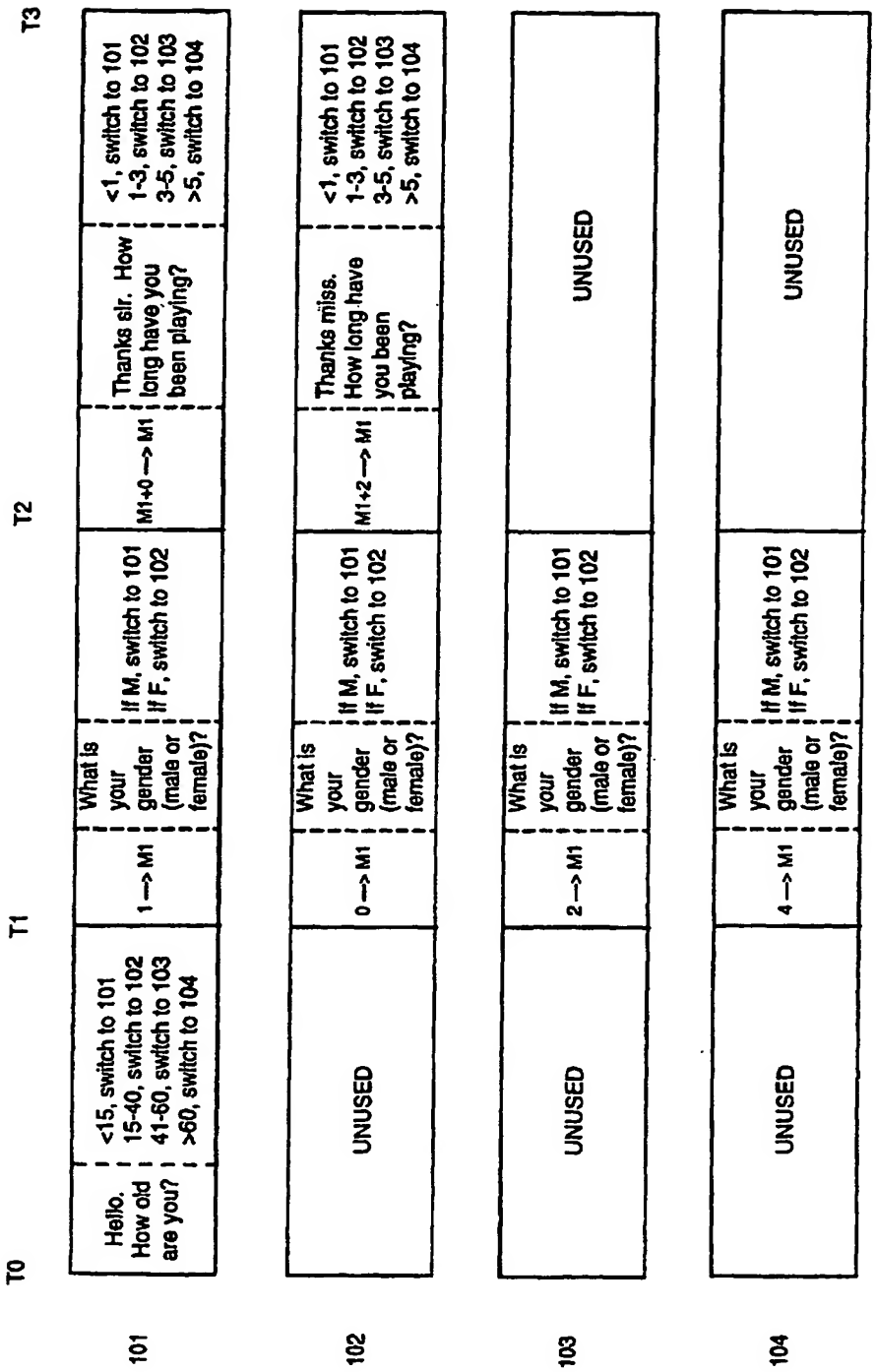
T0
T1
T2
T3
101
Hello. How old are you?
<15, switch to 101
15-40, switch to 102
41-60, switch to 103
>60, switch to 104
1 —> M1
What is your gender (male or female)?
If M, switch to 101
If F, switch to 102
M1+0 —> M1
Thanks sir. How long have you been playing?
<1, switch to 101
1-3, switch to 102
3-5, switch to 103
>5, switch to 104
102
UNUSED
0 —> M1
What is your gender (male or female)?
If M, switch to 101
If F, switch to 102
M1+2 —> M1
Thanks miss. How long have you been playing?
<1, switch to 101
1-3, switch to 102
3-5, switch to 103
>5, switch to 104
103
UNUSED
2 —> M1
What is your gender (male or female)?
If M, switch to 101
If F, switch to 102
UNUSED
104
UNUSED
4 —> M1
What is your gender (male or female)?
If M, switch to 101
If F, switch to 102
UNUSED

FIGURE 8B

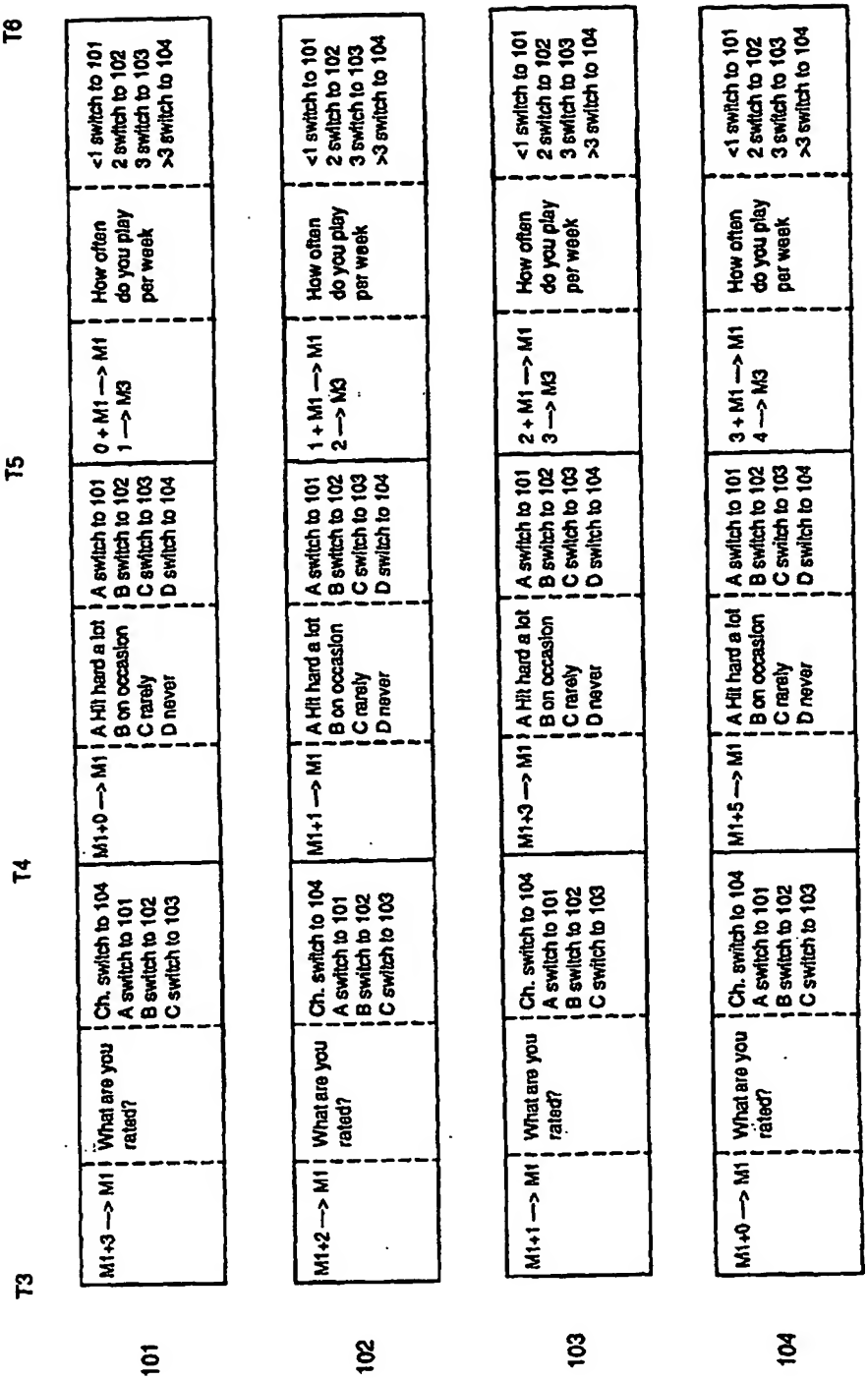
T3
T4
T5
T6
101
M1+3 —> M1
What are you rated?
Ch. switch to 104
A switch to 101
B switch to 102
C switch to 103
M1+0 —> M1
A Hit hard a lot
B on occasion
C rarely
D never
A switch to 101
B switch to 102
C switch to 103
D switch to 104
0 + M1 —> M1
1 —> M3
How often do you play per week
<1 switch to 101
2 switch to 102
3 switch to 103
>3 switch to 104
102
M1+2 —> M1
What are you rated?
Ch. switch to 104
A switch to 101
B switch to 102
C switch to 103
M1+1 —> M1
A Hit hard a lot
B on occasion
C rarely
D never
A switch to 101
B switch to 102
C switch to 103
D switch to 104
1 + M1 —> M1
2 —> M3
How often do you play per week
<1 switch to 101
2 switch to 102
3 switch to 103
>3 switch to 104
103
M1+1 —> M1
What are you rated?
Ch. switch to 104
A switch to 101
B switch to 102
C switch to 103
M1+3 —> M1
A Hit hard a lot
B on occasion
C rarely
D never
A switch to 101
B switch to 102
C switch to 103
D switch to 104
2 + M1 —> M1
3 —> M3
How often do you play per week
<1 switch to 101
2 switch to 102
3 switch to 103
>3 switch to 104
104
M1+0 —> M1
What are you rated?
Ch. switch to 104
A switch to 101
B switch to 102
C switch to 103
M1+5 —> M1
A Hit hard a lot
B on occasion
C rarely
D never
A switch to 101
B switch to 102
C switch to 103
D switch to 104
3 + M1 —> M1
4 —> M3
How often do you play per week
<1 switch to 101
2 switch to 102
3 switch to 103
>3 switch to 104

FIGURE 8C

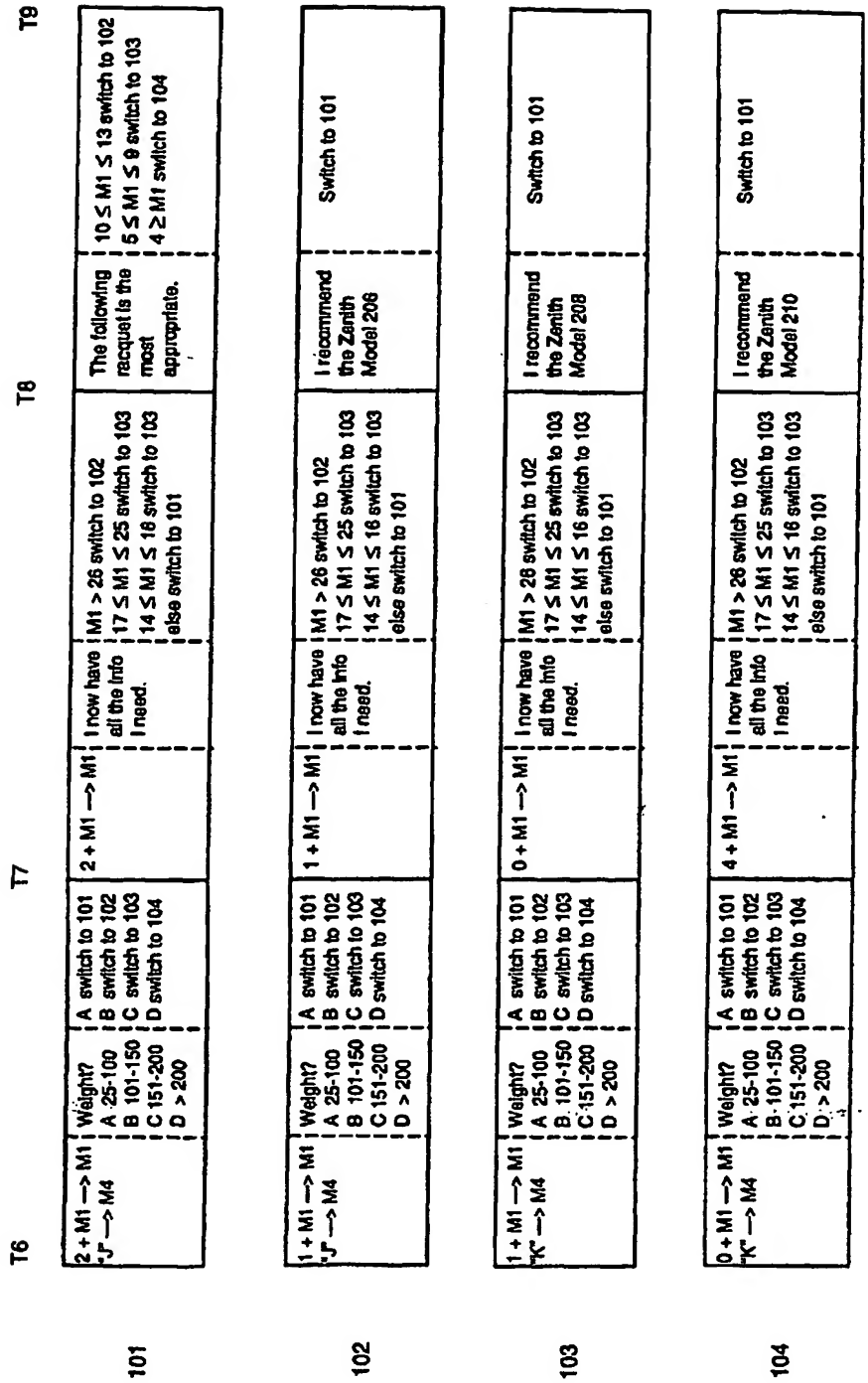
T6
T7
T8
T9
101
2 + M1 —> M1
"J" —> M4
Weight?
A 25-100
B 101-150
C 151-200
D > 200
A switch to 101
B switch to 102
C switch to 103
D switch to 104
2 + M1 —> M1
I now have all the info I need.
M1 > 26 switch to 102
17 ≤ M1 ≤ 25 switch to 103
14 ≤ M1 ≤ 16 switch to 103
else switch to 101
The following racquet is the most appropriate.
10 ≤ M1 ≤ 13 switch to 102
5 ≤ M1 ≤ 9 switch to 103
4 ≥ M1 switch to 104
102
1 + M1 —> M1
"J" —> M4
Weight?
A 25-100
B 101-150
C 151-200
D > 200
A switch to 101
B switch to 102
C switch to 103
D switch to 104
1 + M1 —> M1
I now have all the info I need.
M1 > 26 switch to 102
17 ≤ M1 ≤ 25 switch to 103
14 ≤ M1 ≤ 16 switch to 103
else switch to 101
I recommend the Zenith Model 206
Switch to 101
103
1 + M1 —> M1
"K" —> M4
Weight?
A 25-100
B 101-150
C 151-200
D > 200
A switch to 101
B switch to 102
C switch to 103
D switch to 104
0 + M1 —> M1
I now have all the info I need.
M1 > 26 switch to 102
17 ≤ M1 ≤ 25 switch to 103
14 ≤ M1 ≤ 16 switch to 103
else switch to 101
I recommend the Zenith Model 208
Switch to 101
104
0 + M1 —> M1
"K" —> M4
Weight?
A 25-100
B 101-150
C 151-200
D > 200
A switch to 101
B switch to 102
C switch to 103
D switch to 104
4 + M1 —> M1
I now have all the info I need.
M1 > 26 switch to 102
17 ≤ M1 ≤ 25 switch to 103
14 ≤ M1 ≤ 16 switch to 103
else switch to 101
I recommend the Zenith Model 210
Switch to 101

FIGURE 8D

	T9	T10		T11	T12		
101	The above racquet is the most appropriate	M3 = 1 switch to 101 M3 = 2 switch to 102 M3 = 3 switch to 103 M3 = 4 switch to 104	The string tension should be set at 43	M2 = "X" switch to 101 M2 = "Y" switch to 102	Since you are male, get the wide grip	M4 = "J" switch to 101 M4 = "K" switch to 102	Since you play 3 times a week, buy two racquets	Switch to 101
102	I recommend the Zenith Model 212	M3 = 1 switch to 101 M3 = 2 switch to 102 M3 = 3 switch to 103 M3 = 4 switch to 104	The string tension should be set at 50	M2 = "X" switch to 101 M2 = "Y" switch to 102	Since you are female, get the slender grip	M4 = "J" switch to 101 M4 = "K" switch to 102	Since you don't play very often, one is enough	Switch to 101
103	I recommend the Zenith Model 214	M3 = 1 switch to 101 M3 = 2 switch to 102 M3 = 3 switch to 103 M3 = 4 switch to 104	The string tension should be set at 55	M2 = "X" switch to 101 M2 = "Y" switch to 102	UNUSED		UNUSED	
104	I recommend the Zenith Model 216	M3 = 1 switch to 101 M3 = 2 switch to 102 M3 = 3 switch to 103 M3 = 4 switch to 104	The string tension should be set at 65	M2 = "X" switch to 101 M2 = "Y" switch to 102	UNUSED		UNUSED	

EP 0 782 730 B1